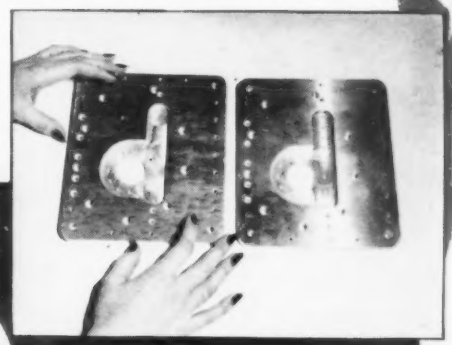
METAL FINISHING
REPARATION, ELECTROPLATING, COATING
BLISHED FOR THIRTY-SEVEN YEARS AS METAL INDUSTRY

LEA Shows the Way

THE PIECES . . . cast aluminum plates

THE PLACE . . .

Pacific Gear Plant
Western Gear Works
Vernon, California



ARMY E ★★ NAVY

Here is a scene typical of those in countless plants where finishing operations are carried on. A bench, a wheel, Lea Compound or Learok and a skilled workman deburring, polishing or buffing a piece by a method devised with the help of the Lea Technical Staff.

Yes, the proper finishing of metals and non-metals calls for a thorough knowledge of the behavior of materials during the various finishing operations. It calls for the broadest experience in finishing . . . in burring, in polishing, in buffing.

It is here that LEA fits into the picture. We have the "greaseless" and "no free grease" compositions — lots of different grades, but it is on our technical service and sound recommendations that we have built and are maintaining our reputation as "Authorities on Finishing Operations."

THE LEA MANUFACTURING CO.

WATERBURY 86, CONNECTICUT

Burring, Buffing and Polishing . . . Manufacturers and Specialists in the Development of Production Methods and Compositions

Over 20,000,000 Man-Hours of Labor, and $40,000,000 of Tax-Payers money has been saved by the efforts of CLEPO Service Men Cooperating with Manufacturing Concerns during the War.

These experienced technical men will give you the same assistance during this critical period of reconversion thereby GETTING YOUR PLANT INTO OPERATION FASTER saving you many Man-hours and Dollars on peacetime products.

FREDERICK GUMM CHEMICAL COMPANY, Inc.
538-542 Forest St., Kearny, N. J.

Founded as METAL INDUSTRY, January, 1903 by
PALMER H. LANGDON
1868-1935

METAL FINISHING

VOLUME 43 SEPTEMBER, 1945 NUMBER 9

Publication Office
11 West 42nd St.
New York 18, N. Y.

L. H. LANGDON
Publisher

THOMAS A. TRUMBOUR
Business Manager

NATHANIEL HALL and
G. B. HOGABOOM, Jr.
Associate Editors

JOAN TRUMBOUR
Advertising Manager

On Leave with the Armed Forces

Palmer H. Langdon
1st Lt. C. E., U. S. Army

PUBLISHED MONTHLY—Copyright 1945 by The Metal Industry Publishing Company, Incorporated, 11 West 42nd St., New York 18, N. Y. Entered February 25, 1903, at New York, N. Y., as second class matter under Act of Congress, March 3, 1879. Re-entered as second class matter June 13, 1940, at the post office at New York, N. Y., under the Act of March 3, 1879.

SUBSCRIPTION PRICES: United States, $2.00 per year; Canada, $2.50 per year (includes 50c exchange and tax). Foreign $3.00. Single copies 25c. Please remit by check or money order; cash should be registered.

ADVERTISING RATES on application. Forms close the 25th of preceding month. Adertising copy should be mailed in time to reach us on or before the 20th of the preceding month.

METAL FINISHING reserves the right to investigate all products offered for advertisement, to refuse advertising considered unsuitable and to edit advertising copy when necessary.

CONTENTS

Editorial 363

Etching Steel With Oxalic Acid Before Industrial Chromium Plating
—By G. R. Makepeace 364

Chemical Processing Prior to Plating and Anodizing—By Carl Hirdler 368

Fundamentals of Science Relating to Electroplating 371

Is the Salt Fog a Test for a "Poor" Nickel Plate?
—By George B. Hogaboom, Sr. 372

Analysis of Silver Plating Solutions—A Simple Electrometric Method
—By J. N. Gregory and R. R. Hughan 374

DEPARTMENTS

This Is Washington 378

Patents 381

Shop Problems 384

New Equipment and Supplies 386

Technical Literature 394

Business Items 395

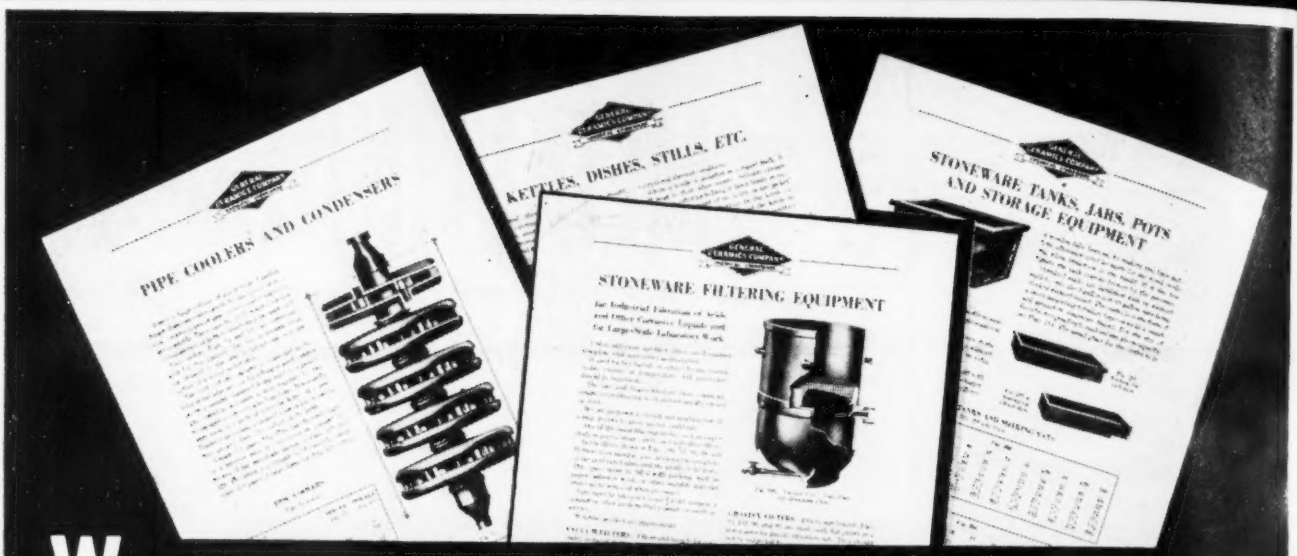
Manufacturers' Literature 399

Associations and Societies 401

Obituary 401

News from California 402

Odds and Ends 65


PIPE COOLERS AND CONDENSERS
KETTLES, DISHES, STILLS, ETC.
STONEWARE FILTERING EQUIPMENT
STONEWARE TANKS, JARS, POTS AND STORAGE EQUIPMENT

WHAT ARE YOUR ACID-HANDLING NEEDS?

Chemical Stoneware Offers Many Advantages to Metal Finishers

Investigate *acid-proof* chemical stoneware for handling corrosive liquids used in cleaning, plating and finishing metal products—particularly for vessels of large size and complicated shapes to which other materials are not usually suited.

Stoneware pickling and plating tanks, storage vessels, piping, valves and pumps made by General Ceramics are impervious to all types of corrosive liquids used in metal finishing, with the exception of hydrofluoric acid. They have no seams or joints, have high mechanical strength, are easy to clean.

General Ceramics can furnish many of the acid-handling stoneware items you need right from stock and, on special items, is prepared to function from blueprint to finished product, to your individual requirements.

Check over the titles of bulletins listed at the right. Any that apply to your problems will be sent to you without obligation. Write for them on your business letterhead.

ASK FOR THESE BULLETINS BY NUMBER

- Centrifugal Pumps .....Bulletin No. 211
- Chlorine Drying Tower, Chlorine Cooler .....Bulletin No. A
- Exhaust Fans and Blowers .....Bulletin No. 1
- Plugcocks and Valves.....Bulletin No. 131
- Filtration Equipment .....Bulletin No. 271
- Kettles, Evaporating Dishes, Stills .....Bulletin No. 171
- Storage Vessels, Rectifying Columns, Gas Generators..Bulletin No. 249
- Photo Engraving Plating and Etching Equipment....Bulletin No. 116
- Pipe and Fittings.....Bulletin No. 151
- Pipe Coolers and Condensers .....Bulletin No. 181
- Tanks, Jars, Pots and Storage Equipment .....Bulletin No. 111
- Tourills .....Bulletin No. 185
- Towers .....Bulletin No. HA

GENERAL CERAMICS AND STEATITE CORPORATION
CHEMICAL EQUIPMENT

BUFFALO: 610 Jackson Bldg. **CHICAGO:** 20 N. Wacker Drive
LOS ANGELES: 415 So. Central Ave. **PORTLAND:** 3019 N.E. 26th Ave.
NEW YORK: 30 Broad Street • **SEATTLE:** 1411 Fourth Ave. • **SAN FRANCISCO:** 598 Monadnock Bldg.
TACOMA: 417 Tacoma Bldg. • **HOUSTON:** 2015 Second National Bank Bldg.
MONTREAL: Canada Cement Bldg. • **TORONTO:** Richardson Agencies, Ltd., 454 King St., West
VANCOUVER, B.C.: Willard Equipment Ltd., 860 Beach Ave.

General Ceramics
AND STEATITE CORP.
CHEMICAL EQUIPMENT DIVISION
KEASBEY, NEW JERSEY

In addition to the manufacturing facilities of the Chemical Equipment Division those of the Insulator Division are also available for handling ceramic problems in all branches of industry. General Ceramics & Steatite Corporation is therefore able to offer service covering all industrial applications of ceramic products.

VOL. 43, NO. 9

METAL FINISHING

PREPARATION, ELECTROPLATING, COATING

SEPTEMBER, 1945

And Now The Peace

The gods of war have had their fill. After six years of the plague, there now exists in all our hearts a thankfulness too profound for expression in further celebration. The metal finishing industry worked hard for this day and, although it will be some time before the awe-inspiring magnitude of its contribution to the downfall of the aggressors will be permitted to be made known, the successful development of a surprisingly large number of new weapons of destruction and defense was made possible only through the employment of plating techniques.

We have been bedeviled by unworkable specifications, unprecedented shortages of labor and materials, overwhelming paper work, unreasonable bureaucracy, unattainable production requirements and unpredictable changes in plans, but the industry has met each of these situations with a resourcefulness of which we can be understandably proud. All that, however, is water under the bridge.

Now we are again engaged in production of civilian needs and must be prepared to meet a new series of problems. Waste and inefficiency, which were formerly accepted on the grounds of military necessity, will be intolerable in a competitive market. Uncle Sam is no longer footing the bill. On the other hand, the strict inspection, which was probably the greatest factor contributing to high rejection rates, no longer confronts the finisher engaged in peacetime production.

The removal of governmental quality control should not be the signal for deterioration of standards. There will be a great temptation, of course, but we must never lose sight of the fact that the successful future of our industry depends on the maintenance of the high standards set by its largest customer during the last four years. Purchasers of finishing services have had a taste of quality and will continue to expect it henceforth.

ETCHING STEEL WITH OXALIC ACID BEFORE INDUSTRIAL CHROMIUM PLATING*

New Pre-treatment for "Hard" Chromium Plating Shows Important Advantages

By G. R. MAKEPEACE

Menasco Mfg. Co.

IT IS well known to platers everywhere that steel to be "hard" chromium plated must first be etched, if a smooth chromium deposit with maximum adhesion to the basis metal is to be obtained. The functions of etching, in so far as they are understood, seem to be three:

1. To remove foreign material, such as rust or oxides and embedded polishing grit, from the surface to be plated and thus to expose a completely clean metal surface. The importance of cleanliness needs no emphasis to a plater.
2. To strip off the outermost skin of severely worked basis metal before plating. Surfaces to be "hard" chromium plated usually are finished by mechanical means such as polishing, buffing, grinding, turning, or some combination of these operations before they enter the plating room. In the process of mechanical finishing, there is a strong tendency towards formation of a superficial layer of highly stressed, severely worked metal. This layer provides a weak bond for the chromium deposit and is likely to result in deficient coating adhesion if not removed.
3. To minutely roughen the surface to be plated. The microscopic roughening of steel surfaces that occurs in the usual methods of etching prior to "hard" chromium plating results in a marked increase of surface area at the interface between the basis metal and the subsequently applied chromium deposit, thus increasing the forces of adhesion. (The beneficial effect of such surface roughening, of course, applies only within limits.)

Whatever may be the relative importance attached to these or other functions of the pre-plating etch, the practical necessity for effective etching is apparent in the plating room and is but rarely overlooked.

Etching Methods

A number of methods for etching prior to industrial type chromium plating have been developed and are in commercial use. Among these may be cited immersion in hydrochloric acid, anodic treatment in sulfuric acid, and anodic treatment in a chromic acid solution or in the plating bath itself. The hydrochloric acid immersion etch generally is held in low repute. The etch itself is slow and non-uniform in attack, parts treated in it are very subject to rusting after the water rinse before plating, the rinse must be thorough to avoid plating bath contamination, and the deposit adhesion obtained through its use is claimed to be poor. From the standpoint of effectiveness, the sulfuric acid anodic etch leaves little to be desired. Metal attack is rapid and quite uniform, oxides and foreign matter on or in the basis metal surface are rapidly removed, and a satisfactory degree of microscopic roughness is developed. Chromium deposits are readily produced in a smooth and entirely acceptable form on a sulfuric acid etched steel surface and show excellent adhesion to the basis metal. The usefulness of the sulfuric acid etch is limited, however, because of the handling difficulties it presents in the processing of large parts. The sulfuric acid solution employed is rather concentrated and is highly destructive to the plater's clothing and to his skin tissue, should it be dripped or splashed on his person. Furthermore, it must be washed thoroughly from the etched parts before they enter the plating bath to avoid unbalancing the latter. This in itself often is no small task, and the handling necessitated increases the personal hazard in the use of the sulfuric acid etch. After rinsing, the parts must be transferred quickly to the plating bath or rusting will occur. With large parts this, too, sometimes is a problem.

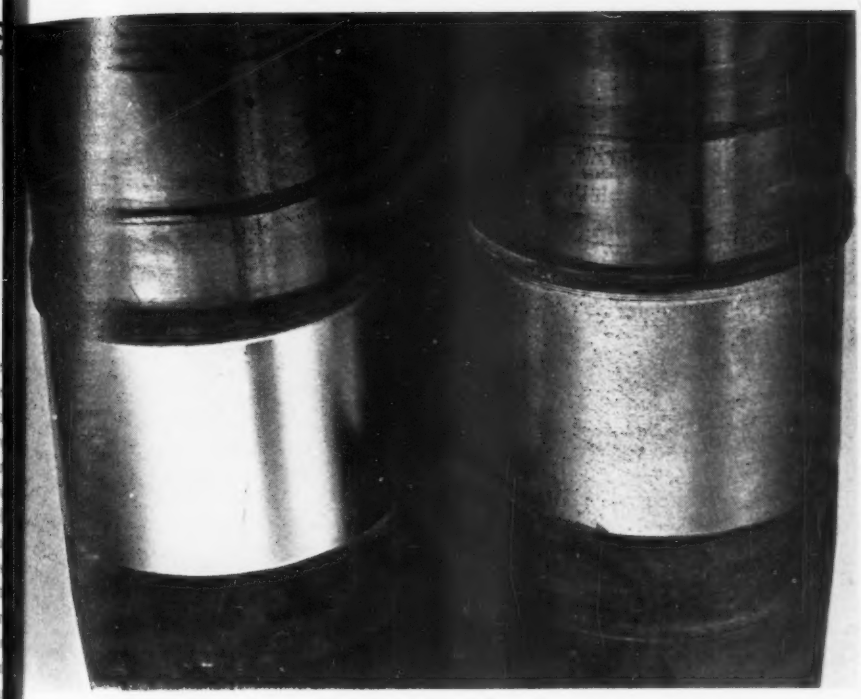
The hazards of the sulfuric acid etch and the inconvenience in the processing cycle it entails by necessitating a careful rinse between the etching and the plating operations have led to wide adoption of a third etching process consisting of anodic treatment in a chromic acid solution or in the chromium plating solution itself. This etching process (U. S. Patent No. 1,645,927, issued in 1927) has obvious advantages in that it permits elimination of a rinse between the etching and the plating operations and avoids all possibility of contamination of the plating bath by the etching solution. The method, however, suffers from certain shortcomings. If the etching is done in the plating tank, the plating solution slowly becomes contaminated with iron and eventually must be discarded due to a decrease in its conductivity. If a separate etching solution is made up, a considerable cost factor enters, since chromic acid is quite expensive and since the effective life of such an etching bath is limited. More importantly still, the etching action of chromic acid is rather slow on many steels. Where a pronounced etch is not required, an anodic treatment in the chromic acid solution of only a minute or so duration often is adequate. In some cases, however, much more severe attack is required if a subsequent smooth deposit of chromium free from nodulation is to be obtained. Prolonged etching has been found necessary particularly in the case of heat-treated chromium-molybdenum steels such as are widely used in aircraft manufacture. It has become common practice to etch parts made of these steels for as long as 10 to 20 minutes prior to plating. When such long etching times are used, the etching tank becomes a production bottleneck. What is more, the current consumption in the anodic chromic acid etching process is very high, ranging from 1 to 3 amperes per square inch of surface etched. When an etching period of, say, 15 minutes is used, the percentage consumed in the chromic acid etching process of the low voltage d.c. power available to a chromium plating shop may amount to as much as 10% of its total power capacity. Obviously, this is an unreasonable price to pay merely for convenience in parts handling.

Requirements

Some years ago, a program was established at Menasco Mfg. Co. which had as its purpose the development of a pre-plating treatment for industrial chromium deposition that would combine the convenience of the anodic chromic acid etch with the speedy effectiveness of the anodic sulfuric acid process. The requirements for the new etching solution and process were to include:

1. Sufficient compatability with the plating solution to permit direct transfer of etched parts to the plating tank without an intervening water rinse.
2. Rapid operation and full effectiveness on all types of low and medium alloy steels.
3. Low consumption of electric current.
4. Low enough corrosive activity in the absence of current flow to permit a certain amount of delay in transferring parts from the etch to the plating solution.
5. High rust-removing activity.
6. Non-destructiveness to clothing and to skin tissue.
7. Freedom from objectionable fumes and serious health hazards.
8. Low cost both per gallon of solution and per square foot of surface etched.
9. Operation with readily available equipment and preparation from available materials.
10. Ease of maintenance and control.

*(U. S. Pat. Application No. 552813.)



Two identical bearings before regrinding, salvaged by chromium plating 0.040" thick. Left etched in oxalic acid, right etched in chromic acid.

Oxalic Acid Etching

After considerable investigation, an etching process was developed which appears to fulfil all of the above requirements. In brief it consists of anodic treatment at room temperature in a 10% solution of oxalic acid containing added wetting agent. In plating shop practice, a water solution containing 12 to 14 oz. per gallon of oxalic acid (Technical grade) is prepared in a tank made of wood, glass, ceramic material, or steel lined with lead, rubber, plastic, asphalt or almost any acid resistant material commonly used by platers. Since oxalic acid dissolves slowly, the solution either should be stirred frequently for some time or else, more conveniently, be agitated with an air hose for a few hours as a part of its preparation. After the oxalic acid is dissolved, a small amount of a wetting agent of the sodium aryl sulfonate type is dissolved in warm water and then stirred into the etching solution. (Oronite Wetting Agent, 1.0 oz. per 100 gallons of etching solution is used at Menasco.) The purpose of the wetting agent is to promote uniform etching attack by preventing bubbles from clinging to the surface being etched. No other materials are added to the etching solution. The etching tank is supplied with a source of low voltage direct current capable of operating at about 6 volts; the ordinary plating type of generator is suitable. The tank in most cases is fitted with permanent, "pocket" type cathodes, which may be made of lead or stainless steel. The work to cathode spacing should be fairly uniform around the individual work piece, but the actual spacing is not critical and may vary from one to four or five inches. The cathode area to work area ratio should be at least 1:1, with excess cathode area desirable. If the chromium plating anodes are attached to the work holding fixture, as it often the case, processing in the "pocket" type of etching tank arrangement is inconvenient, since the work then must be racked after etching. It is possible to use the plating fixture for etching merely by connecting it backwards with the work as anode, in the etching tank. This tends to contaminate the etching solution with chromium compounds rather quickly, but the oxalic acid solution is little affected by contamination of this type. Wherever possible, however, it is much better to use permanent cathodes in the etching tank.

The part to be plated is racked and cleaned, using a good alkaline cleaner—preferably of the electrolytic type. After cleaning, the part is rinsed thoroughly in fresh cold water. Then it is transferred to the oxalic acid etching solution. It is important that the surface to be etched be covered with solution *before* the etching current is connected. After the part is positioned in the etching tank, the current is turned on, using 6 to 8 volts at the tank. The etching current density which results varies from 0.5 to 1.0 ampere per square inch, depending upon anode-cathode relationships, solution concentration, etc.; it is not critical. For the first few seconds of etching no gassing occurs on the work, but the attack is rapid and the work becomes covered with a green film of ferrous oxalate. Then gassing starts at one or more points and quickly spreads over the entire work surface, sweeping away the green film and leaving a satiny-grey, cleanly etched finish. Once started, gassing continues and further etching proceeds quite slowly. The initial period of non-polarized etching should last from 10 to 20 seconds if conditions are properly adjusted. A total etching period of 30 seconds to 1 minute usually is employed to produce a clean surface suitable for plating. After etching, the part is transferred to the chromium plating tank *without rinsing* and is plated in the usual way. Omission of the rinsing step is possible because oxalic acid, when introduced into the chromium plating solution, decomposes immediately according to the following general equation:

$$3(COOH)_2 + 2\,CrO_3 + 6H^+ \rightarrow 6\,CO_2 + 6\,H_2O + 2\,Cr^{+++}$$

It will be noted that the products of the reaction are carbon dioxide, which escapes immediately from the warm acid solution as a gas; water, which is of no consequence; and a small amount of trivalent chromium. During the normal operation of chromium plating baths, trivalent chromium rapidly is oxidized at the anodes and restored to its original hexavalent state.

The only difficulty likely to be encountered anywhere in the process is failure to obtain gassing, with consequent failure to sweep away the green ferrous oxalate film formed during the depolarized etching period; this results in over-etching and leaves a dirty surface unsuitable for plating. Trouble of this kind may be caused by anything which tends to depolarize the anode surface, but the common shop causes are:

1. Too low an oxalic acid concentration
2. Too low an etching voltage
3. Contamination of the etching solution with chloride (muriatic acid).

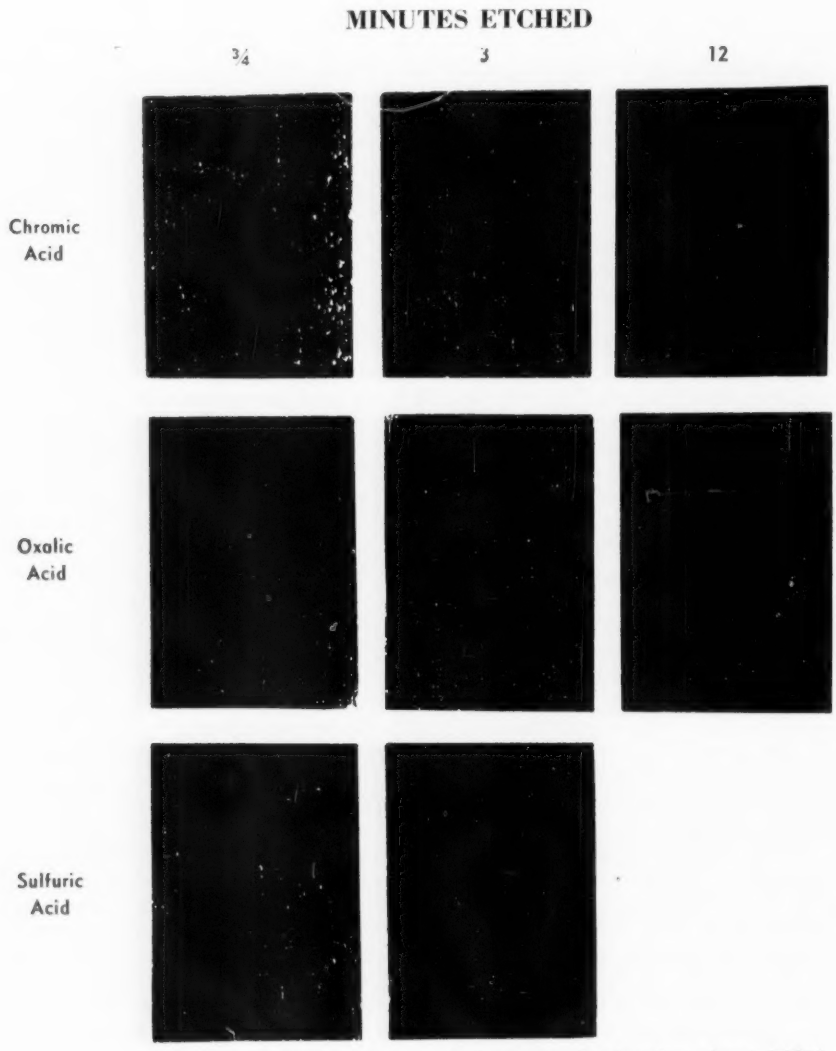
Effect of Variables

A more detailed discussion of the effects of common variables on the operation of the oxalic acid etching process perhaps is in order at this point. It will by this time have become apparent that the effectiveness of the process depends very largely upon maintaining a proper balance between an initial etching period in which the anodic surface is depolarized and a second period in which it becomes polarized. During the depolarized period, anode dissolution takes place at nearly 100% current efficiency, hence etching is extremely rapid. During this phase of etching, a greenish scum of insoluble ferrous oxalate accumulates on the anode surface and must be removed before plating can be started. The polarization of the anode surface—which normally occurs 10 to 20 seconds after the etching process is started—results, first, in a greatly reduced rate of attack on the anode surface and, second, in a vigorous evolution of oxygen. The combination of these effects serves to sweep away the initially formed ferrous oxalate scum and to leave a cleanly etched surface eminently well suited to receive a chromium deposit. It was mentioned earlier that a part to be etched must be completely wet with the oxalic acid solution *before* it is made anode in the electrical etching circuit. This stipulation is necessary because many steels, including hardened chromium-molybdenum aircraft types, polarize instantly if they are introduced into the etching solution while already connected with the 6 volt power source. This causes the depolarized, rapid etching stage to be omitted, and results in the production of a very mild, shallow etch. Apparently it is the presence of a thin, preformed film, perhaps of ferrous oxalate, that depolarizes the anode during the first stage of etching. The depolarized phase,

however, must be metastable and tend quickly to break down if extreme over-etching is not to occur. The influence of relatively high current densities and electrode potentials in causing polarization is well known, and the reasons for the effect have already been amply discussed in works on theoretical electrochemistry. The requirement for speedy polarization makes the attempt to use etching potentials of less than 6 volts inadvisable. For the same reason, the use of sufficiently large cathode areas to prevent cathode polarization from limiting current flow is mandatory; likewise the anode-cathode distance should be small enough to eliminate solution conductivity as a limiting factor. The concentration of oxalic acid in the etching solution also has an important effect on polarization. At concentrations of 2 to 7% by weight of acid, enough conductivity is imparted to the solution to permit rapid etching, but the depolarization film tends to break down rather slowly unless very high tank voltages are used. Higher concentrations tend to correct this condition, hence a practical recommendation is for use of an etching bath containing concentrations from 10% to saturation of oxalic acid. The effects of temperature on the operation of the oxalic acid etching bath are not significant within a rather wide range. Any changes normally encountered near room temperature, 50-100° F., seem not to be important. At high temperatures—120-200° F.—the tendency for polarization to occur decreases, and proper operation of the etching process becomes difficult. The effects of high temperature partially can be overcome by the use of high concentrations of oxalic acid—close to saturation for any given temperature—and high tank voltages, but no special advantage seems to be conferred by high temperature etching. Since the cost of etching at high temperatures is considerably greater than it is at room temperatures, room temperature etching conditions are recommended.

The time of exposure to oxalic acid etching is important, but is variable with the part being etched and the type or degree of etch desired. If mere removal of a superficial oxide film is required, this can be accomplished by simple immersion without the use of current. Only slight etching is produced in this way, however, and the plating deposit adhesion is likely to be poor. For work on specially accurately and finely machined parts such as thread gages, where heavy etching cannot be tolerated and heavy deposits of chromium are not to be applied, very short etching periods of 3 to 5 seconds are used. While the entire etching period is, in this case, in the depolarized phase, the total etching time is so short that no appreciable film of ferrous oxalate has an opportunity to form. This type of etching is recommended only for special work. For general work where heavy deposits of chromium are to be applied and the maximum beneficial effects of a vigorous etch are required, the etching time used should be that period which is required to complete the depolarized etching phase plus at least 15 seconds in the polarized phase to clean the work of the ferrous oxalate film. Longer etching times in the polarized phase of the process have relatively little effect unless they are greatly protracted.

The oxalic acid etching bath is notably unaffected by moderate degrees of contamination with most of the substances likely to be introduced. Chromic acid and chromates are reduced in the bath and, in the process, destroy a small amount of oxalic acid. Aside from this unimportant effect, the presence of as much as 0.1% of chromium, added as chromate, in the bath seems not to influence its operation. The effect of ferrous iron is not appreciable up to the limit of its very slight solubility as ferrous oxalate. It may be this very slight solubility of ferrous oxalate, as compared to the higher solubilities of the ferrous salts of many other simple organic acids, that makes possible the two phase oxalic acid etching process. Oxidized (ferric) iron is very soluble in the etching solution, but as much as 0.5% of ferric iron (as the oxalate) in the etching bath, has no noticeable effect on the operation of the etching process. Lead, up to the limit of its very small solubility in the etching solution, does not affect it, nor does the addition of four times the recommended amount of wetting agent. In fact, the only common contaminant which seems to influence the oxalic acid etching process appreciably is the chloride ion which exerts a pronounced depolarizing effect.



Effects of preplating etches on steel test panels chromium plated 0.005" thick. White spots are nodules.

Performance

The final test of any process is, of course, its practical performance. The oxalic acid etching process has met this test upon properly prepared laboratory samples and—more characteristically—in production with complete success. As determined from a year's experience, rejections of finished work in the Menasco plating department for pitting and nodulation have been reduced to less than ½ the percentage considered normal (on rigidly inspected precision parts) prior to the adoption of oxalic acid etching. A not unusual example of the effectiveness of oxalic acid etching in reducing the tendency to nodulation is illustrated by Plate I, showing two salvaged axles (before re-grinding) built up on the bearing surfaces with .040" of chromium. The parts both are made of heat treated chromium-molybdenum steel, were ground undersize to the same diameter before plating, and in all ways were treated identically throughout processing except that one was etched 1 minute in oxalic acid and the other 5 minutes in chromic acid, before plating.

While non-adhesion of chromium has never been a serious problem at Menasco it is significant to note that to our knowledge, no chromium plated part pre-treated in oxalic acid has ever been rejected or has failed in service because of poor deposit adhesion. Quality performance combined with processing simplicity and power saving made the oxalic acid etching bath so popular after an experimental period in the Menasco plating department that it was accepted as the exclusive etching process for production use.

The record of effectiveness of the oxalic acid etch in production is supported by laboratory test panels. In the following typical series SAE 4130 steel panels 2" x 4" x ¼" thick, heat treated to a hardness of Rockwell C-40 and cleaned up on a production surface grinder using emulsion coolant, were finished by surface grinding dry on a belt sander, using sharp No. 120 aluminum oxide grit coated belts. This treatment produced generally smooth, "glazed" surfaces containing some rather deep scratches, and caused severe surface working and local overheating. The general surface condition of the panels was uniformly poor—as intended—for reception of chromium plating. After surface grinding, the panels were numbered and racked in individual, insulated spring racks, being held at the ends by the rack contactor points with the test faces freely exposed. No stop off materials or "thieves" were used. After racking, the panels were cleaned anodically at 7 volts for 30 seconds in a hot proprietary electrolytic cleaner solution, etched as described below, and transferred to the chromium plating solution (after a water rinse in the case of the sulfuric acid etched panels). The plating solution contained 33 oz. per gallon of chromic acid and was operated at a 100:1 chromic acid: sulfuric acid ratio. Its temperature was thermostatically maintained at 131° F. The panels were permitted to hang in the plating solution in every case for exactly 5 minutes before the power was turned on to permit them to come to the temperature of the bath. After the warmup period, the supporting racks were connected to the bus bars of the tank at a steady tank potential of 4.7 vols. The anodes were of antimonial lead and were hung so as to form square pockets 11 inches across. Each panel was centered in its pocket 5" from the nearest anode face. The exact current flow per panel so obtained was not measured precisely, but was approximately 35 amperes, or slightly less than 2 amperes per square inch of surface exposed. Plating was continued for 5 hours in every case before the panels were removed and examined. The results of the tests are shown in Plate II.

Panels 1, 2, and 3 were etched ¾, 3, and 12 minutes respectively in the chromic acid plating solution described above, using a panel face-cathode spacing of 2½ inches and a tank potential of 7 volts, which resulted in a current flow of about 4 amperes per square inch of surface etched. The etching bath temperature was 140° F.

Panels 4, 5, and 6 were etched ¾, 3, and 12 minutes respectively in a 12 oz. per gallon oxalic acid solution containing .01 oz. per gallon of Oronite wetting agent. A panel face-cathode spacing of 2½ inches was used, and a tank potential of 7 volts, which resulted in a current flow of about ¾ ampere per square inch of surface etched. The etching bath temperature was 75° F.

Panels 7 and 8 were etched ¾ and 3 minutes respectively in 52° Baumé sulfuric acid solution, using a panel face-cathode spacing of 2½ inches, and a tank potential of 7 volts, which resulted in a current flow of approximately 1½ amperes per square inch of surface etched. The etching bath temperature was 75° F. The 12-minute etch was omitted, since the maximum beneficial etching obviously had taken place in 3 minutes.

Study of Plate II shows a uniform improvement in surface smoothness with increased time of etching in the case of Panels 1, 2, and 3, and likewise in the case of Panels 8 and 9. The oxalic acid etched Panels 4, 5, and 6, however, show a peculiar progression of surface quality change with increased time of etching. Panel 4, etched ¾ minute, is quite smooth; Panel 5, etched 3 minutes, is much rougher again; yet Panel 6, etched 12 minutes, is completely smooth and free of nodulation. This anomalous series might be considered the result of uncontrolled differences in individual panels, a freak of some sort, but repetition of the experiment on different panels reproduced the condition. No entirely satisfactory explanation of the phenomenon has as yet been advanced.

It is notable that of the panels etched ¾ minute, the one treated in oxalic acid is much the smoothest and best, and the one treated in chromic acid the poorest. Of the panels treated 3 minutes, the chromic acid etched panel and the oxalic acid etched panel are of about the same quality—none too good. The sulfuric acid etched panel is completely smooth and of excellent quality, though it shows some pattern of etching reproduced by the chromium plating. The panel etched 12 minutes in oxalic acid is completely smooth, and also free from any trace of etching pattern. It displays the finest quality chromium plating of any of the panels. The panel etched 12 minutes in chromic acid is fairly good, very similar to the panel etched ¾ minute in oxalic acid. The close resemblance between surfaces etched 45 seconds in oxalic acid and those etched from 10 to 15 minutes in chromic acid also has been noted on production parts made of heat treated SAE 4130 steel. Tests for deposit adhesion were made on all the above panels by taper grinding through the plating at a 10 degree angle to a feather edge, and were confirmed by bend testing 4130 sheet steel panels .030" thick similarly prepared. In all eight cases the adhesion of the plated chromium deposit was found to be excellent.

Advantages of Oxalic Acid

It is apparent that the oxalic acid etching process is very much more economical than the chromic acid process from the standpoint of current consumption. The instantaneous current demand of the production etching tank at Menasco has been reduced to ½ and the total ampere-hours of low voltage d.c. consumed by the etching process have been reduced to 1/20 the demand of the same flow of work passing through the anodic chromic acid etching process formerly used; this has provided badly needed relief for overloaded generator capacity. The decided economies, compared with both the chromic acid and the sulfuric acid processes, effected by the speed and convenience of oxalic acid etching are equally important. The magnitude of the saving in all cases is appreciable, in some cases very substantial. The cost of the solution itself is important, too, especially to a small plating shop which may not be able to risk much money in experimenting with new processes. A 12 oz. per gallon oxalic acid etching solution costs, with oxalic acid at $15.00 per 100 lbs., some 11½ cents per gallon for chemicals. A 52° Baumé sulfuric acid solution, with sulfuric acid at $2.00 per 100 lbs., costs about 17 cents per gallon for chemicals. A 33 oz. per gallon chromic acid solution, with chromic acid at $20.00 per 100 lbs., costs approximately 41 cents per gallon for chemicals. No less important than the first cost of a processing solution is its durability. In this regard, oxalic acid etching solutions also comapre favorably with the others. In the production chromium plating shop at Menasco one 200 gallon oxalic acid etching tank has kept 3,500 gallons of chromium plating solution working 24 hours a day at near capacity for almost a year. During this period the etching solution has been changed only three times. The bath has etched over 5,000 square feet of steel surface per 100 gallons of solution, with no sign of deterioration. The only tangible criterion for discarding an oxalic acid etching solution is the accumulation in it of so much iron that drag-over of this metal into the chromium plating solution presents a problem. It has been the practice at Menasco to discard the etching solution when its iron content reaches 3 grams per liter.

A final point that will appeal to platers is the ease with which the composition of the oxalic acid etching solution may be controlled. The only analysis necessary is an infrequent one for iron content. Day to day, concentrations of oxalic acid are maintained merely by taking density readings with a Baumé hydrometer. Observation of foaming on the tank surface suffices to control wetting agent content, although precise surface tension measurements are desirable if apparatus is at hand.

On every count, oxalic acid etching is recommended to platers who deposit industrial chromium on steel, but particularly is the new method recommended to those working to rigid specifications on heat-treated alloy steels. To the latter group this communication is addressed with the hope that because of it their work will be made just a little easier and just a little more pleasant.

Acknowledgment

The assistance, encouragement, and many helpful suggestions of Mr. James Houston, foreman of the plating department at Menasco, are gratefully acknowledged to have been instrumental in the production development of oxalic acid etching.

CHEMICAL PROCESSING

Prior to Plating and Anodizing

By CARL HIRDLER

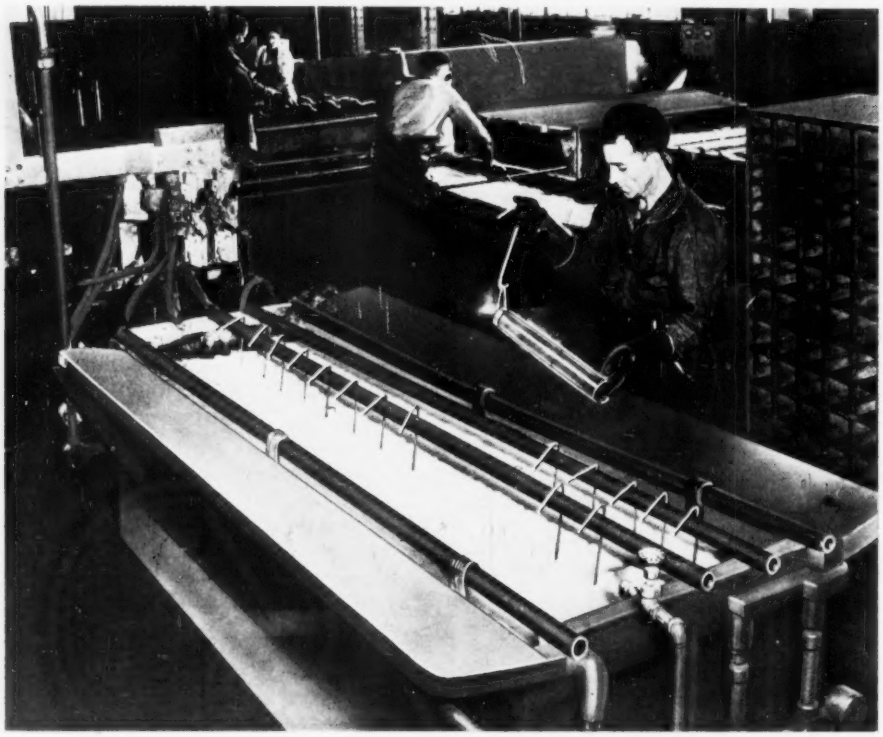
Chemical Research Engineer, Turco Products, Inc.

THE effective preparation of the metal surface for plating has always been a problem to electroplaters. During the past five years the pressure of war has brought so much new research and experience to bear on the solution of this problem, that a review of what has been learned should be helpful to electroplaters in charting the paths ahead.

Cleaning plays so vital a part in plating because of one of the peculiarities of the electric current, its tendency to flow over the surface of an object. In order that the entire surface may be plated, it is necessary that the electric current pass through every portion of the surface as it makes contact with the plating solution. When the surface is coated with matter which resists the flow of electrical current (such as grease, oil, and dirt) or with foreign particles whose resistance is greater than the surface being plated, successful plating cannot take place. For this reason it is necessary to remove grease, oil, dirt, metal chips, rust, scale and other contaminating matter in order that a smooth, tightly adherent, unbroken plating job be obtained.

The electroplater cleans in order to obtain a uniform, equally distributed flow of electric current over the work which he wishes to plate. Experience and research have established that there is no one cleaning method or material which will satisfy this requirement under all conditions. A cleaning method is uniformly effective only if it is tailored to remove a particular kind of dirt from a particular kind of metal, under a given set of conditions. These conditions include the quality of plating which is required, the time and the equipment available for cleaning, and the amount of manpower which can be utilized. Never to be overlooked is the nature of the water used in making up both the cleaning and plating solutions, since this may have a profound influence on both operations.

Since there is no single, simple answer to a plater's cleaning headaches, his problem becomes one of diagnosis. The plater must decide what his cleaning problem is, and then choose a cleaning method which will be successful in terms of his particular problem. It is hoped that the information presented here will be helpful to the plater, both in making a proper diagnosis, and in selecting an adequate cleaning procedure based on that diagnosis.



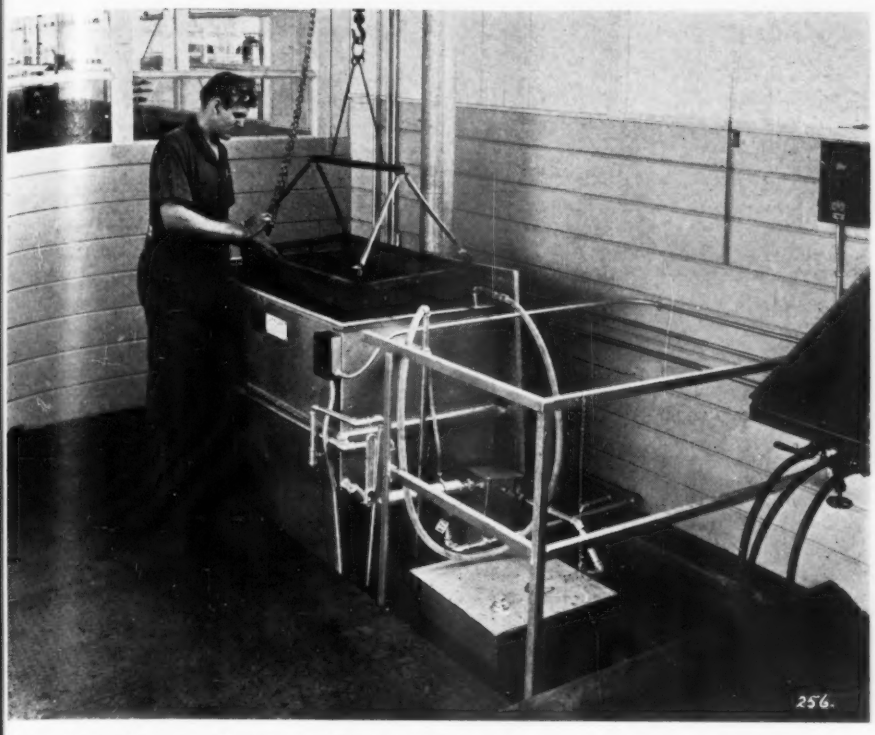
The method of electrocleaning prior to plating is being adopted by more and more platers. The electric current acts on the cleaning solution to produce millions of tiny gas bubbles which "blow" oil and dirt from the surface of the work.

Cleaning Methods

Five distinct cleaning methods are available to platers at the present time. In one of these, or in a suitable combination of these methods, the plater will find the answer to his cleaning problem.

One of the earliest methods of cleaning practised by platers is solvent wiping. Parts are either dipped into the solvent and then wiped with a dry cloth, or are wiped with a solvent saturated rag. Solvents which might be used are kerosene, Varsol solvent, Stoddard solvent, oleum spirits, naphtha, or any one of a number of fluids with grease and oil dissolving properties. Wiping is an essential part of the operation, since solvents have no effect on solid particles, or on inorganic contamination. The major advantage of the solvent cleaning procedure is its versatility. It can be used on any kind of part, and requires a minimum of equipment. Unskilled labor can be utilized, but since most solvents are either flammable or toxic or both, their use presents a health and safety problem. The nonflammable solvents are relatively costly. The major disadvantage of the solvent method of cleaning is that it does not produce the chemically and physically clean surface so vital for uniform adhesion of the plating metal. Because of this limitation, solvent cleaning should be used only to remove gross contamination prior to process cleaning before plating is begun.

Vapor degreasing is a development from the solvent method of cleaning. It utilizes equipment, however, which replaces the manual wiping action with a washing action. Solvents are heated until they vaporize, and the cold parts exposed to the hot solvent vapors. The vapors condense on the surface of the parts, assume liquid form, and flow down the parts back to the receptacle from which they were originally evaporated. The solvents act on oil and grease, while the flowing action tends to wash solid particles into the boiler. The solvent evaporating from the bottom of the boiler is clean, since non-



Vapor degreasing—an efficient method for precleaning a considerable volume of work in small space.

volatile dirt remains behind. Periodically the boiler must be cleaned out to remove solid particles and sludge. The solvents commonly used in vapor degreasers are either modified trichlorethylene or perchlorethylene. In the vapor degreaser, these solvents may be considered to be nonflammable. Both are toxic, however, and their use presents some hazard to personnel.

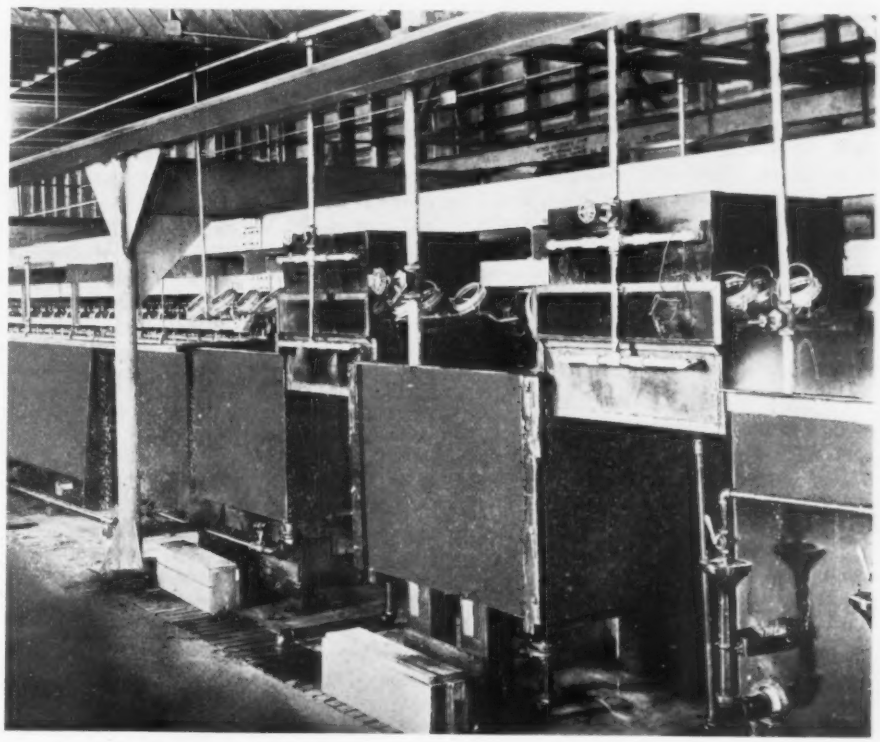
Vapor degreasing has a number of significant advantages. It permits the solvent to be reused repeatedly, it removes all oil and grease, it is fast, permits the handling of a large volume of work in a piece of equipment which requires relatively small floor space. However, vapor degreasers must be properly maintained or they will not function efficiently, thus boosting operational costs. It must also be remembered that while vapor degreasing will remove all oil and grease, it will not remove all solid particles and miscellaneous dirt. Vapor degreased surfaces cannot be considered to be physically and chemically clean, so that additional treatment of the metal will be required if uniformly successful plating results are to be achieved.

Steam cleaning is a third method of cleaning available to platers. Modern steam cleaning equipment produces a wet steam in which a certain amount of steam cleaning compound has been dissolved, thereby multiplying the detergent effect of the heat and pressure released in the steam blast. If the right steam cleaning compound is selected, and if the cleaning and rinsing operations are efficently handled, steam cleaning can provide physically and chemically clean surfaces. The unit cost is slight if a large volume of work is handled daily. This method is applicable for the cleaning of large units and large assemblies, but, where a considerable number of small parts are to be handled, or where the work is intricately shaped or creviced, steam cleaning will present difficulties.

The most commonly accepted method of cleaning small parts in volume is through the use of a hot tank containing a water solution of an alkaline cleaning compound. To avoid contamination of the hot tank, many platers utilize a method of precleaning which removes gross oil, grease, and dirt before the work is immersed for process cleaning. Emulsion cleaning is favored by many platers for this purpose. Emulsion cleaners are chemicals which, when added to solvents, increase the emulsifying, wetting, and penetrating properties of the solvent, and at the same time render the solvent and the loosened dirt freely rinseable in water. Emulsion cleaners have been formulated for various specialized jobs, ranging from the quick removal of oils and greases to the removal of obdurate paint coatings, baked-on carbon, and engine "varnish." Emulsion cleaners can be applied by dipping, spraying, or brushing. Rinsing may be accomplished in an agitated rinse tank, by hose, in an air and water spray, and under some circumstances in an air and solvent spray. Since emulsion cleaning is primarily a method of precleaning, the work should then be process cleaned in order to obtain a physically and chemically clean surface.

To produce the degree of scrupulous cleanliness required for quality plating, most platers have adopted an immersion treatment in an alkaline cleaning solution in the hot tank. Is there an all-purpose hot tank cleaning material? This question may safely be answered with a categorical no! Tremendous differences in the chemical and physical behaviour of the various kinds of metal, as well as differences in the kinds of dirt to be removed require a very specialized approach to the selection of a hot tank cleaning material. A discussion of the problems involved in cleaning aluminum and steel by tank immersion will demonstrate this point.

Since a surface chemically and physically clean is required for the uniformly successful anodizing of aluminum, the use of a powerful alkaline cleaner to produce such a surface would appear logical. Unfortunately,



A mechanized plating installation in which the work passes from an alkaline hot tank to a hot rinse, then to pickling and rinsing tanks, all by means of overhead conveyors.

Steam cleaning will produce a chemically and physically clean surface when it is properly applied and an efficent, modern steam cleaning compound is used.

conventional alkalies attack aluminum with almost savage destructiveness. For this reason chemicals such as lye or caustic soda are quite impractical and dangerous for use in the cleaning of aluminum. However, modern science has produced cleaners with a sufficiently high degree of alkalinity for effective cleaning but inhibited (through the use of certan silicates) against attack on aluminum. But the use of silicates brought in its wake a new problem, since at high temperatures silicates tend to bake on the work and create rinsing difficulties. Other substances had to be found to counteract this tendency without impairing the value of the silicates in preventing attack on aluminum. Alkaline cleaners are now available which are completely noncorrosive to aluminum and free rinsing; but, while there is no reason why such cleaners could not be used to clean steel, it must be remembered that they never can process the very high degree of alkalinity which is safe and desirable for the still tank cleaning of steel. It is therefore most economical to use them for the specific job for which they were chemically designed—the safe cleaning of aluminum.

The problems involved in the still tank cleaning and electrolytic cleaning of steel will throw further light on the complex engineering incorporated in modern cleaning compounds. To completely remove grease, oil and solid particles in the still hot tank, a number of physical and chemical forces must be mobilized. A maximum degree of active alkalinity must be made available to supply a full quota of cleaning energy. Water conditioning must be provided for to prevent the depositing of hard water film on the work. Wetting action must be brought into play to bring the cleaning solution into intimate contact with the dirty surface and to enable it to penetrate the dirt; other factors which must be brought together are powerful emulsifying action to disperse oil and grease, saponifying action to dispose of fatty acids, deflocculating ability to dispose of solid particles, buffering action to prolong the life of the cleaning solution. However, cleaners with a high degree of emulsifying ability normally require high temperatures to keep them in solution and may therefore present rinsing difficulties, even though the rinse water is maintained near the boiling point. Accordingly, in a scientifically designed compound for the still tank cleaning of steel the formula is engineered to overcome this difficulty so that complete rinsing, therefore completely clean work, is reliably produced.

Alkaline electrolytic cleaners present problems which are quite different. Here the cleaning action is aided by the flow of electric current which reacts with the cleaning solution to form millions of tiny gas bubbles at the surface of the metal which tend to blow dirt and grease off the work. For this reason a high degree of emulsifying ability is not required, nor need the degree of alkalinity be as high as is necessary for still tank cleaners. It is therefore possible to stress water conditioning and free rinsing properties to a much greater extent than is possible in hot tank cleaners. It is for this that electrolytic cleaners may be satisfactorily rinsed in cold water, while still tanks require a minimum rinse temperature of 180° F. for most effective results.

Fundamental in the choice of a cleaning material for use in the hot tank is its behaviour in relation to hard water. If the cleaning material does not effectively control the minerals dissolved in most natural water supplies, gummy, adhesive residues, water spots, and rinsing troubles are the almost inevitable result. Soda ash, still used by many platers as a water softener, does its work by reacting with hard water minerals to form an insoluble, nonadherent sludge which will settle to the bottom of the tank, from which it may be periodically removed. If the cleaning tank is not regularly maintained, however, this sludge may be deposited on the work to be plated. Recent chemical research has made it possible to design cleaning compounds which soften the water without the formation of precipitates. The hard water minerals are prevented from interfering with the cleaning action, and at the same time are held in solution, so that sludge, water spots, and streaks are avoided. Rinsing is more complete so that the work that goes into the plating tank has achieved the highest degree of cleanliness.

The key to successful cleaning is the selection of a cleaning method specialized for the kind of work which is being cleaned, the kind of dirt to be removed, the characteristics of the metal being treated, and the degree of cleanliness required. When the plater has all these factors in mind in evaluating his cleaning methods, his reward is more uniform plating quality, a smoother rate of production, and a minimum of production troubles.

FUNDAMENTALS OF SCIENCE RELATING TO ELECTROPLATING

ANODE REACTIONS

CHAPTER X defined electrolysis as the process of electrochemically decomposing an electrolyte, for example, the electrodeposition of a metal from a solution of one of its salts. Previous chapters have also indicated that electrolysis can be broken down into a consideration of what goes on in the vicinity of the cathode, in the vicinity of the anode and in between these two. Although the principal features of what goes on in each of these places have been discussed, this chapter and a subsequent one will describe in some detail other phenomena connected with the anode and cathode.

When a voltage is applied to an electrolyte, such as an acid copper plating solution, the anions—in this case the sulfate ions, SO_4^{--}, and the hydroxyl ions, OH^-—travel to the anode. What happens in the vicinity of the anode then depends on, among other things, the composition of the anode.

Assume first that the anode is soluble in the electrolyte, like copper in the acid copper bath. Then the following occurs:

$$Cu \rightarrow Cu^{++} + 2e$$

Copper Metal — Copper Ions — Electrons

The metallic copper anode dissolves in the bath to furnish copper ions and two electrons, the latter being neutralized by two positive charges at the anode. Differently stated, the metallic copper—with valence zero—is oxidized to bivalent copper. The solution is thus replenished with copper ions, to replace the copper ions being removed from the solution at the cathode. The current efficiency at the anode in this case is approximately 100%.

In the case of insoluble anodes, the situation is, of course, different. Anodes are said to be insoluble when they do not form metal ions in the solution and under the conditions being considered. This is merely another way of saying that the anode is "passive." Between this condition with 0% anode current efficiency and the case of the completely soluble anode with 100% anode current efficiency, there exists the entire range of partly soluble or partly passive anodes.

When insoluble or passive anodes are used, one of three things, or a combination of these three things, must happen:

1. Oxygen may be liberated. In this case the reaction that takes place at the anode is given by the following:

$$4\,OH^- + 4\,F = 2\,H_2O + O_2$$

The use of the item "4 F" is to indicate that 4 Faradays are used to neutralize the 4 hydroxyl ions, the neutralization of the negative charges being accomplished by the positively charged anode. The oxygen is liberated, and since the hydroxyl ions are consumed in this process, an excess of hydrogen ions remains and the solution in the neighborhood of the anode tends to become more acidic, with lower pH. Agitation and diffusion minimize this tendency. Perhaps the best industrial illustration of this type of reaction is the commercial production of oxygen by the hydrolysis of water. Generally a solution of sodium or potassium hydroxide is used. The anodes in this case are usually nickel plated steel and the current efficiency for producing oxygen runs over 99%.

2. An anion other than oxygen may be liberated, depending on the relative overvoltages and potentials involved. For example, under certain conditions, chlorine will be liberated by electrolysis of a salt (NaCl) solution in accordance with the following equation:

$$2\,Cl^- + 2\,F = Cl_2$$

Again the "2 F" indicates neutralization of the negative chlorine anions at the positive anode by the passage of the classical number of coulombs (2 Faradays).

3. Reactions at the anode are always oxidizing in nature. Even the liberation of a gas is an oxidation reaction since the valence has been increased from a negative value to zero. Sometimes, however, this oxidation shows itself otherwise. A familiar example is in the chrome plating solution where, at the lead anode, the following takes place:

$$Cr^{+++} + 3\,F = Cr^{+VI}$$

The trivalent chromium is oxidized to hexavalent chromium (chromic acid). Sometimes, also the nascent (active) oxygen produced at the anode may accomplish the oxidation of certain products.

Many industrial examples involving the reactions at the anode could be given. Some have already been mentioned. In addition, might be mentioned the common lead storage battery, where the lead is oxidized to form lead sulfate, the production of numerous chemicals such as persulfates, perborates, permanganates, white lead and iodoform, and the refining of certain metals.

Passivity has often been broken down into types such as electrochemical, chemical and mechanical. Fundamentally, however, all these types fall back on the same explanation for passivity, namely, the formation of an insoluble film or layer on the anode which prevents the anode from dissolving further. Sometimes the film is thin and invisible, like certain oxide films; sometimes there is present an appreciable layer of salts visible to the naked eye, such as in the case of a lead anode in a chromic acid solution. Sometimes the barrier (film or layer) is quite impervious and/or a poor electrical conductor; sometimes it is relatively porous and/or a poor electrical conductor, permitting anions like chlorides to migrate through the film and discharge. All these factors contribute to the degree of passivity of the anodes. It should be noted that, when passivity sets in, the electrode potential of the metal changes to make the metal more noble; thus the potential of active nickel under one set of conditions in salt water is —0.24 volts and of passive nickel is —0.07 volts.

With these thoughts in mind, it is easy to understand some of the causes and effects connected with passivity. Thus, in silver plating, under certain conditions silver may dissolve from the anode more rapidly than free cyanide can reach the anode to keep it dissolved. The result is that in the immediate neighborhood of the anode, insoluble silver cyanide is formed in accordance with the following reaction:

$$Ag^+ + KAg(CN)_2 = K^+ + 2AgCN$$

Silver ions — Potassium Silver Cyanide — Potassium ions — Silver Cyanide Precipitate

The silver cyanide coats the anodes gradually. Since it is not an electrical conductor, the active area of the anode gradually decreases. As this area decreases and the current is kept constant, the current density increases. As previously explained, as the current density increases the polarization increases, and with it the bath voltage. The voltage may also be increased due to the small conducting area. Thus the soluble silver anode has become an insoluble passive anode. Suppose now that excess cyanide reaches or is added to the anode region. Then the silver cyanide is dissolved as described in a previous chapter, as follows:

$$AgCN + KCN = KAg(CN)_2$$

Silver Cyanide — Free Cyanide — Soluble Potassium Silver Cyanide

As soon as the barrier of insoluble silver cyanide is thus removed, the anode ceases to be passive. An interesting experiment can be performed simply, by using relatively high anode current density in a low free cyanide bath. If the current density and free cyanide are suitably adjusted, and the voltage kept constant, the anode coats over with silver cyanide, the current drops, silver ceases to be dissolved, free cyanide reaches the anode and dissolves the coating, the anode passivity thus disappears and the current increases. As the current reaches its original value the anode coats over again and the whole cycle is repeated. Thus the anode is alternately dark and light, dark and light—like flashes—corresponding to passive and active surfaces.

Another interesting example is a lead anode in sulfuric acid (as in a storage battery), to which is analogous the lead used as an anode in chrome plating. On electrolysis, insoluble lead sulfate is formed which coats the anode just as the silver cyanide did in the previous example. As electrolysis is continued, the voltage increases but now, unlike the silver cyanide, oxidation takes place and converts the sulfate to persulfate, which then decomposes to form insoluble lead peroxide on the anode. Lead peroxide

(*Continued on page 393*)

IS THE SALT FOG A TEST FOR A "POOR" NICKEL PLATE?

By GEORGE B. HOGABOOM

Consultant, New Britain, Conn.

WITH increase in the length of time required in the "Salt Fog" for nickel coatings on steel, i. e., from 50 to upwards of 200 hours, it seemingly would indicate that nickel is soluble in a salt fog atmosphere. This is borne out by the requirement for a heavier nickel coating on steel when the longer salt fog tests are designated.

A general investigation was made, and the results warrant a more exhaustive research. It is of importance to manufacturers of products that are to be nickel plated and are required to meet definite specifications. It is also of importance to the electroplater who exerts every effort to produce a good coating of nickel on steel, yet at times is at a loss to explain why some of the products do not "stand up in the salt fog."

Attention has already been focused on "what is under the plate." Now it is directed to "what is *in* the plate." It is well known and has been established by numerous investigations that there can be inclusions in any electrodeposited metal. The effect of these inclusions on the character and physical properties of the electrodeposited coatings in relation to outdoor exposure or any accelerated test, e. g., salt fog, hot water or humid atmosphere, is important. There have been published data on the effect of some addition agents in nickel solutions upon the physical characteristics such as the crystal size and lamination phenomenon. Practically all of these investigations have been concerned with electrodeposited nickel; few, if any, with coatings obtained from alkaline plating solutions.

A research project on the effect of addition agents, wetting agents, etc., on electrodeposits from the alkaline plating solutions will, it is predicted, unearth much valuable data and present answers to some of the problems that now exist relative to bright or heavy deposits or coatings that will act as good undercoats for another electrodeposited metal and also have good protective properties. All too much is taken for granted, and, when a "break down" does occur, due to a lack of substantiating data as to the real source of trouble, one of the operations in the preparation of the basis metal, or of the control of the plating solution is generally at fault.

Attention, one day, was called to a salt fog test of a sheet of electrodeposited nickel which had been stripped from the basis metal. The sheet of nickel was very porous, and the statement was made that a weighing, both before and after the salt fog test, had shown practically no loss of metal. This was surprising, as the salt fog test was for 200 hours. The nickel coating had been produced in a bright nickel solution.

It was recalled that several years ago a bright deposit of nickel on brass screws would not withstand the trichloracetic-aqua ammonia test. The screws were plated in a barrel and cadmium was used as the brightening agent. The brass screws plated in a nickel sulphate solution containing no cadmium withstood the test perfectly.

It was thought that in all probability cadmium was co-deposited with the nickel and was dissolved by the test solution. A hole was drilled through a screw that had been plated in the cadmium nickel solution, and a hole was also drilled through a screw plated in a regular nickel sulphate solution. The two screws were placed in a solution of ammonium nitrate until all the brass was dissolved and only the shells of the nickel coating remained. The shell from the screw plated in the solution containing no cadmium was without a pin-hole; the shell from the screw plated in the nickel-cadmium solution had many pin-holes, in fact, looked like a fine mesh sieve.

It is well known that colloidal substances in nickel plating solutions are electrically carried to the cathode and are included in the nickel deposit. As there was practically no loss of weight of the electrolytic nickel sheet which was tested in the salt fog, it was surmised that the colloidal substances were dissolved by the salt solution of the fog test in the same way as cadmium was dissolved in the test of the nickel-cadmium deposit.

A piece of cold rolled steel that had a highly finished surface was thoroughly cleaned, then treated with the well-known separatory material—sodium dichromate and finely divided graphite—and plated in a proprietary bright nickel solution, the exact composition of which is not known, except that it contained organic brightener and a wetting agent. This solution had been in use for a long time, and, therefore, the colloidal substances had sufficient time to form in quantities that could be electrically charged and be carried to the cathode, probably to be included in the nickel deposit.

As it has been generally assumed that a nickel deposit would have to be thicker than 0.001", a deposit above that thickness was

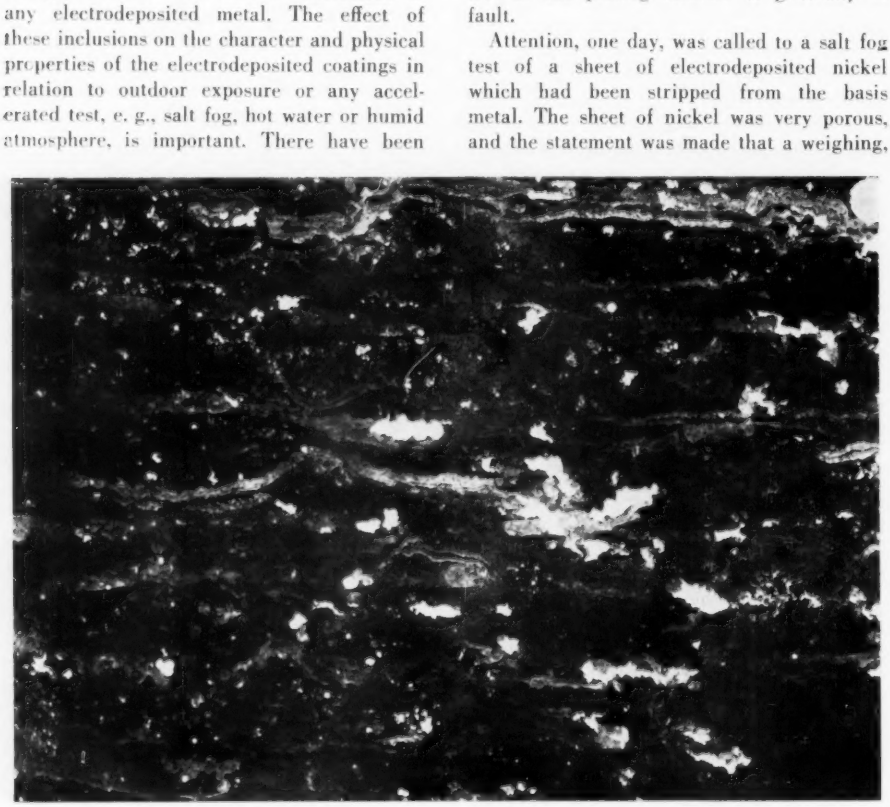


Fig. 1. Deposit from bright nickel solution after 50 hrs. in salt spray. White spots are perforations.

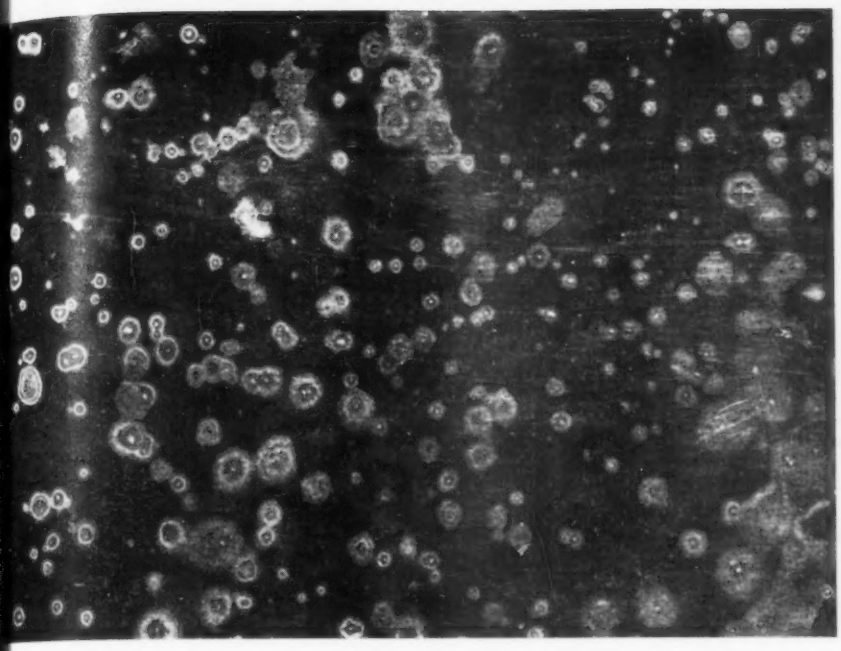


Fig. 2. Deposit from Watts nickel solution after 50 hrs. in salt spray. Light spots are stains. No perforation visible.

ted on the test specimens. At the same e, other pieces of steel, treated in the e manner with a separatory material, re plated in a Watts-type nickel solution h approximately the same thickness of posit.

The nickel deposit was carefully stripped m the steel and examined; there was no osity in either test piece. These sheets of ctrolytic nickel were placed in a salt fog paratus in which the spray and the tem- rature are controlled.

Examination, after 50 hours, of the nickel et that was plated in the Watts solution wed no sign of porosity. The nickel sheet ted in a bright nickel solution, however, d the appearance of a heavy lace (Fig. 1). e sheet from the Watts nickel solution was laced in the salt fog for another 50 hours, d no porosity developed (Fig. 2). A deposit m a nickel solution containing no addition nts showed only two pin-point holes after hours (Fig. 3).

t appears evident from these preliminary ts that an investigation of the protective ue of bright nickel deposits should be de. A correct salt fog value is probably not obtained when the nickel plated steel is tested. The real value of the nickel deposit as a protective coating can be determined only by testing the nickel deposit itself in the manner given above.

The tests should be made in a nickel solution that has been in operation for some time, as some organic addition agents may not be included in the deposited nickel until they are oxidized or reduced by electrolysis. Some colloidal substances travel to the anode at one concentration and to the cathode at another concentration; and, in all probability, there are some that travel to the anode and/or the cathode depending upon the intensity of the electric current.

It will, no doubt, also be found that metallic brightening agents will be included in the nickel deposit and be dissolved by the salt solution in the salt fog test.

It may be that, in the very near future, the electroplater will be called upon to produce nickel plated work that will meet more severe salt fog specifications. It will save considerable discussion if the above test is tried so that the correct source of porosity of nickel deposits can be determined.

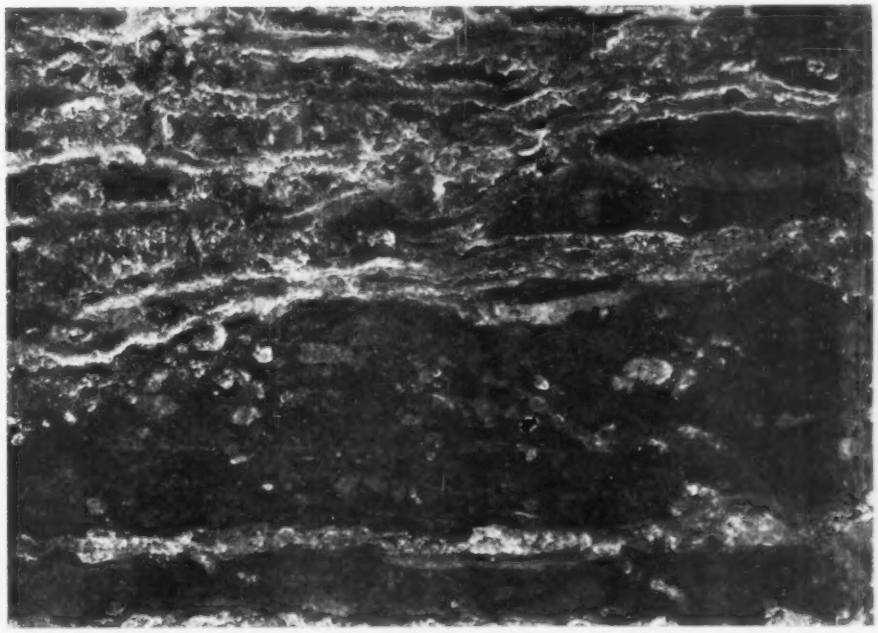


Fig. 3. Deposit from dull nickel bath after 576 hrs. in salt spray. Only 2 pinhole perforations visible.

ANALYSIS OF SILVER PLATING SOLUTIONS
A Simple Electrometric Method

By J. N. GREGORY and R. R. HUGHAN

Lubricants and Bearings Section, Council for Scientific and Industrial Research, Melbourne, Australia

Methods for the electrometric determination of free cyanide and argenticyanide in silver plating baths are described. Both ions can be determined by the same run of the buret with silver nitrate solution. The end points are detected by null-point readings on a galvanometer. The method requires inexpensive equipment and is very rapid and easy to carry out. The effect of other ions often found in electroplating solutions has also been investigated.

IN A previous paper (2) it was shown that an estimate of free cyanide and argenticyanide in a silver plating solution could be obtained by titration with silver nitrate solution. The free cyanide was estimated by the well-known Liebig method, in which the solution is titrated to the first sign of turbidity owing to the formation of silver cyanide after the reaction

$$2KCN + AgNO_3 = KNO_3 + KAg(CN)_2 \qquad (I)$$

is completed.

Further addition of silver nitrate involves the reaction

$$KAg(CN)_2 + AgNO_3 = KNO_3 + Ag_2(CN)_2\downarrow \qquad (II)$$

It has been shown that the end point of this reaction can be detected by the use of potassium chromate as an indicator, provided the solution is buffered with excess of boric acid. In this manner, with an electroplating solution containing potassium cyanide and potassium argenticyanide, the difference between the titration to complete precipitation of silver cyanide and twice the Liebig titration on a similar aliquot is equivalent to the argenticyanide originally in the solution.

Wick (5) and Müller and Lauterbach (3) investigated the variation of potential of a silver electrode in solutions of alkali cyanide during titration with silver nitrate. It was found that there were two distinct sudden changes in the potential during the titration. The first change occurred at the end of the first reaction (I), and the point of maximum variation of e.m.f. coincided with the appearance of turbidity. The second fluctuation in e.m.f. occurs when the silver cyanide is completely precipitated at the end of the second reaction (II).

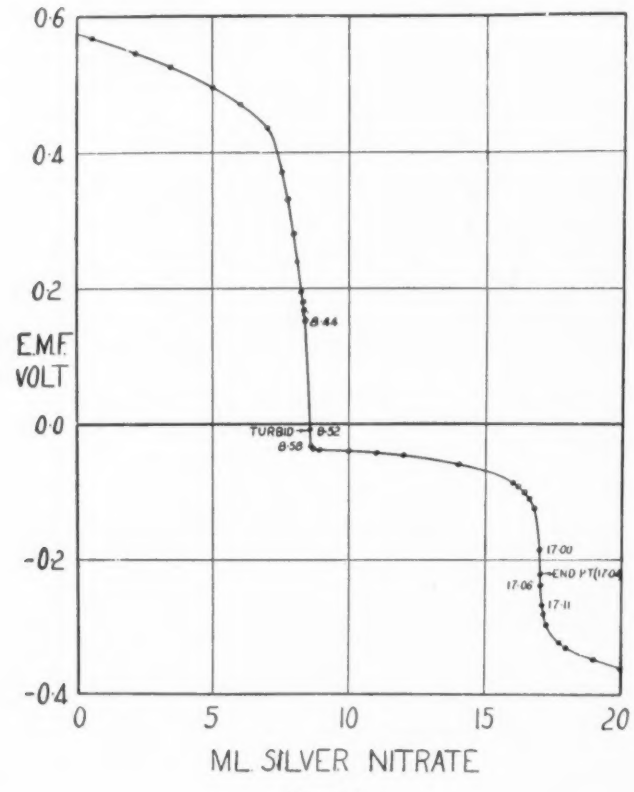


Figure 1

The silver-ion concentration at this point is increasing very rapidly owing to complete precipitation of the silver cyanide with consequent increase in the e.m.f. of the silver electrode. The second point of inflection took place when exactly twice as much silver nitrate as for the first point of inflection had been added. Thus the e.m.f.–silver nitrate curve represents accurately the two stages of the reaction, precipitation of silver cyanide.

Read and Read (4) have also described an electrometric method of estimating argenticyanide in conjunction with Liebig's titration. In this method the electrodes are of platinum and tungsten, respectively. Towards the end point of the second stage of the reaction the potential of this system (indicated by a vacuum tube voltmeter) shows a slight rise, followed by a sudden drop at the end point. Various suggestions are made in this paper as to the theory of the action of this method and why it is sensitive to a change in silver-ion concentration. The same authors describe a method of detecting the end point of the second reaction by the use of diphenyl carbazone as an internal indicator. A color change from violet to a dirty blue occurs at the end point.

Müller and Lauterbach have studied the effect of the presence of halides on the electrometric titration curve of cyanide, and have shown that, as each halide is precipitated in turn according to its solubility, a marked discontinuity occurs in the curve at points which are equivalent to the amount of halide present. In this manner halogens can be determined electrometrically in the presence of cyanide.

Cavanagh (1) has described a simple absolute method of potentiometric titration in which the e.m.f. at the end point of the titration is counterbalanced by an equal and opposite e.m.f. The end point of the reaction is then indicated by a null reading on a galvanometer in series in the circuit. In the reactions to which this is applicable there is a rapid change in e.m.f. at the end point and a very sensitive detection is possible with a moderately sensitive galvanometer. Only an approximate adjustment of the counterbalancing potential is required in this titration, since at the end point the addition of 0.1 ml. of 0.1 *N* solution often causes a change of 50 to 100 millivolts in the e.m.f.

Cavanagh used this method for the titration of halides with silver nitrate. He ensures zero e.m.f. at the end point by having a quinhydrone electrode as his reference electrode and a silver–silver halide electrode as the reversible variable electrode. The pH of the solution is then adjusted by addition of nitric acid of known strength until the potential of the quinhydrone electrode is known to be equal and opposite to that of the silver halide electrode at the end point.

In the case of the chloride titration, the e.m.f. of the cell is given by:

$$E = 0.474 + 0.0575 \log_{10}(C_{H^+} \times C_{Cl^-})$$

C_{H^+} and C_{Cl^-} are the concentrations of hydrogen and chloride ions respectively.

At the end point of the reaction C_{Cl^-} is equal to the square root of the solubility product of silver chloride,

$$C_{Cl^-} = 0.97 \times 10^{-5}$$

From this it may be calculated that, for E to be zero at this point, the value of C_{H^+} should be about 0.00055 *N*. This adjustment can be made with sufficient accuracy by addition of the necessary amount of standard nitric acid from a graduated pipet. The cell is then simply connected in series with a tapping key, suitable resistance

Reprinted with permission of the American Chemical Society, from Industrial and Engineering Chemistry, Analytical Edition, February, 1945.

d a galvanometer and the titration is continued until the galvanometer passes zero deflection.

The object of the present investigation was to endeavor to apply the variation of the potential of the silver electrode to a simple and rapid method for determining the cyanide and argenticyanide concentration of plating solutions. As the method is intended for routine control with limited facilities, speed and simplicity of operation are the essential requirements. An accuracy of ±1% is sufficient for this estimation.

Experimental

Titration of Pure Cyanide Solutions. At first experiments were carried out to determine whether Cavanagh's method could be applied to the precipitation of silver cyanide by silver nitrate, and, if so, what concentration of hydrogen ion gives the correct potential of the quinhydrone electrode. The adjustment of hydrogen-ion concentration is necessarily restricted by the instability of cyanides which occurs even in weakly acid solutions. It so happened, however, that a saturated solution of boric acid (pH = 5.0) gave the correct hydrogen-ion concentration. Thus the solution was adjusted in a manner similar to the titration with chromate indicator (*2*). Pure 0.2 *N* potassium cyanide was titrated with 0.2 *N* silver nitrate first by the Liebig method, and second by the procedure outlined below.

A 20-ml. aliquot was diluted to about 40 ml. and then the silver nitrate solution was added until there was almost sufficient to precipitate the cyanide. At this stage, excess boric acid and about 0.5 gram of quinhydrone were added and stirred well. A silver and a bright platinum electrode were each inserted in the solution and connected via a tapping key and variable rheostat to a galvanometer. The addition of silver nitrate was then continued slowly until the addition of one drop caused a change in deflection of the galvanometer from the *+ve* to *−ve* direction.

The Liebig titration is a reliable method, and by it one can obtain the potassium cyanide concentration of the solution relative to the silver nitrate. If the electrometric end point is correct, then it should give a titer exactly twice that of the Liebig method. The results obtained are given in Table I.

Table I. Titers

(20-ml. aliquots of KCN)

Titers by Liebig Method	Titers by Electrometric Method
Ml.	*Ml.*
9.51	18.87
9.47	18.96
	18.99
	18.94
Av. 9.49	18.94

Ratio of electrometric to Liebig titer = 1.997.

A measurement of the e.m.f. of the silver electrode against the saturated calomel electrode showed a value of 0.42 volt as the equivalence point. The e.m.f. of a quinhydrone electrode is 0.41 volt at pH 5.0. Thus, from a theoretical basis, the e.m.f. of the combination should be zero at the end point of the reaction.

This method, if applied to the analysis of electroplating solutions, would require two titrations (the Liebig titration for free cyanide and the electrometric for argenticyanide). It was felt that it would be an advantage to be able to do the two estimations on the same run of the buret. The Liebig and electrometric method described above could not be combined, since the former requires dilution to about 600 ml. in the presence of carbonate ion, which is nearly always present in silver plating solutions, while the latter requires the minimum possible volume of solution.

Figure 1 shows the titration curve of 0.2 *N* potassium cyanide solution with 0.2 *N* silver nitrate, using a silver electrode with a saturated calomel electrode as reference electrode. The calomel electrode was connected to the solution via a 25% ammonium nitrate bridge. The ammonium nitrate bridge was used to prevent the solution becoming contaminated with chloride ions. The cell set up was thus:

$$\text{—Ag} \;\; \underset{\text{(titrated solution)}}{\text{Ag}^+} \;\; \text{:25\% } NH_4NO_3 \text{:Satd. KCl:} Hg_2Cl_2\text{:Hg—}$$

A 20-ml. aliquot of potassium cyanide was taken and diluted to 600 ml. for this titration. It is seen that there is a very large drop

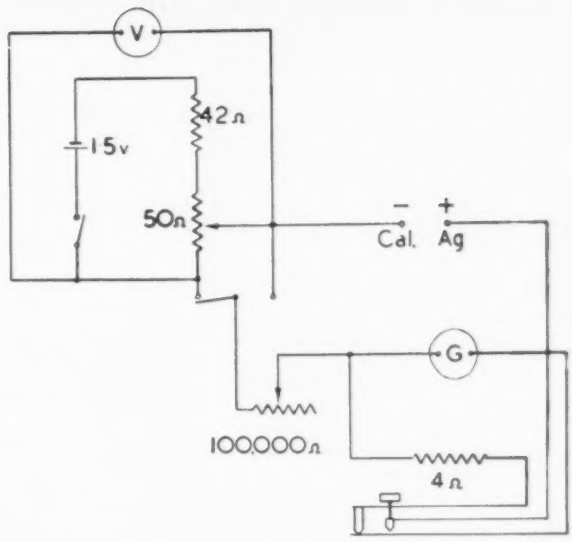


Figure 2

in e.m.f. at the first end point, and the e.m.f. passes zero at the point of appearance of turbidity (8.52 ml.). The second point of inflection of the curve corresponds to complete precipitation of silver cyanide and the volume now is exactly twice the first (17.04 ml.). The sensitivity is such, at the end point, that one drop of silver nitrate causes a change of 50 millivolts in e.m.f. These results were obtained consistently under the same conditions, and variation of the amount of dilution between 200 and 600 ml. had practically no effect on the titers or the e.m.f. at the end points. The values of the e.m.f. at the end points were zero and —0.21 to —0.22 volt, respectively (the calomel electrode was taken as *+ve* at the beginning of the titration).

Using the equation

$$E = 0.80 + 0.058 \log_{10} (C_{Ag^+})$$

where C_{Ag^+} = concentration of silver ions

it can be calculated that the e.m.f. at the equivalence point (where $C_{Ag^+} = \sqrt{S.P.\ Ag_2(CN)_2} = 1.5 \times 10^{-6}$) should be —0.21 volt against the saturated calomel electrode. This is in close agreement with the observed value of —0.21 to —0.22 volt for the point of inflection of the curve.

The detection of the first end point is a simple matter in this case. One can either use the appearance of turbidity or the zero e.m.f. (null point on galvanometer in series).

For the simple detection of the second end point, a method suggested by Müller and Lauterbach and Cavanagh can be used—i.e., after passing the first end point, an e.m.f. of 0.22 volt is applied in series in the circuit in the opposite direction to the cell e.m.f. The resultant e.m.f. is thus 0 at the second end point, and the titration

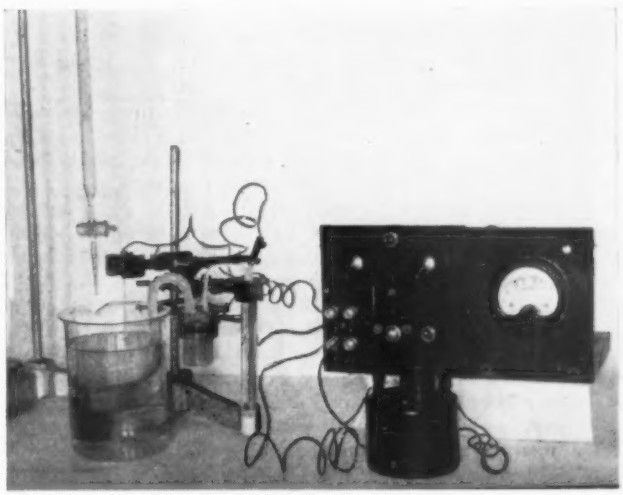


Figure 3

electrode $E = 0.80 + 0.058 \log_{10} C_{Ag^+}$, it can be calculated that

explain. It seems that a fairly complicated series of reactions occurs,

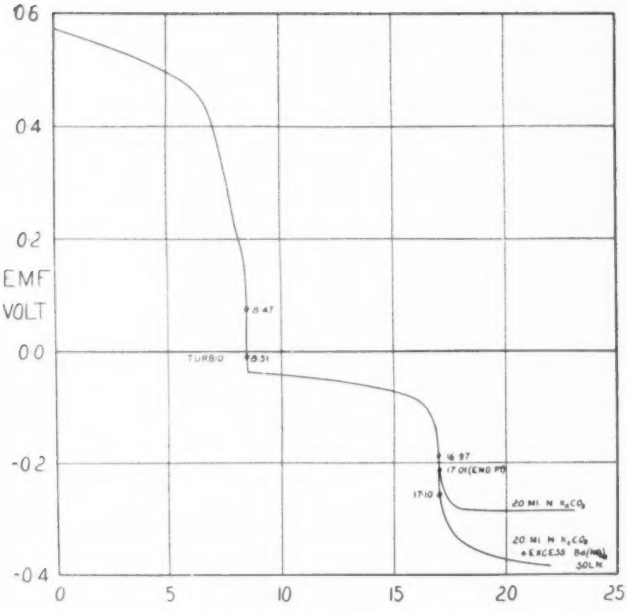


Figure 4

can be continued until a series galvanometer again shows a zero deflection. The e.m.f. is applied by means of a potentiometer circuit, and the complete circuit is shown in Figure 2. An e.m.f. up to 1.0 volt can be placed in the circuit by adjustment of the potentiometer and its value read on the voltmeter. The potentiometer can be switched out of the circuit if desired, for detecting the first end point. The press button in the galvanometer circuit is designed with its free position in open circuit, a light pressure closes the circuit with a low resistance shunt on the galvanometer, and a heavier pressure removes the shunt, with the circuit still closed. In this manner the first pressure enables one to detect currents which might otherwise ruin the galvanometer if connected directly. The 100,000Ω variable

Table II. Titers on Pure Cyanide Solutions

Conditions of Titration	Titers of 0.2 *N* $AgNO_3$ To 1st end point *Ml.*	To 2nd end point (0.22 volt) *Ml.*	Ratio of Titers
20 ml. of 0.2 *N* KCN diluted to 250 ml.	9.43	18.82	1.997
	9.37	18.70	1.997
20 ml. of 0.2 *N* KCN diluted to 600 ml.	9.34	18.70	2.002
	9.36	18.73	2.001
20 ml. of 0.3 *N* KCN diluted to 600 ml.	15.41	30.81	2.000
	15.43	30.81	1.996

series resistance is used also to protect the galvanometer when relatively large e.m.f.'s are present. Figure 3 shows the layout of the circuit and galvanometer setup used in this work.

In detecting the second end point, the potentiometer is set on 0.22 volt and switched into the circuit. Silver nitrate solution is then added, the circuit being closed after each addition until the deflections start to decrease slowly. The series resistance may then be reduced and the titration continued slowly. At the end point, with the series resistance right out, the addition of one drop of silver nitrate causes a full-scale deflection on one side of the galvanometer to change to a full-scale deflection on the other side.

Table II shows the results of titers carried out on pure cyanide solutions by this method. The titer to the Liebig end point (turbidity) corresponded exactly to the galvanometer null point in all cases. This end point is again used as a standard for comparison of the second end point, as it is impossible to weigh out accurate samples of cyanide. The ratio between first and second end points gives an indication of the accuracy of the second end point.

The method gives reliable and accurate results on pure cyanide solutions. Silver electroplating solutions, however, also contain alkali carbonate added intentionally and sometimes small quantities of other ions introduced during the working of the plant by corrosion of the baths, electrodes, etc., and it is essential that the effect of these ions should be investigated. Chloride ion is a common impurity usually introduced in the chemicals used for making up the baths. Traces of iron, copper, and other heavy metals are present as complex cyanides. These are usually acquired by corrosion of the plant and objects being plated, etc.

Effect of Other Ions on the Titration. *Carbonate.*

To 20 ml. of 0.2 *N* potassium cyanide were added 20 ml. of potassium carbonate, making the solution 0.5 *N* with respect to carbonate. This is the concentration which is used frequently in electroplating solutions. The titration curve of this solution, when diluted to 600 ml., is shown in Figure 4. (The cyanide is the same solution as used in Figure 1.) It is seen that, owing to the greater solubility of silver carbonate than silver cyanide, the carbonate has no appreciable effect on the titration curve until after all the silver cyanide is precipitated. The light brown silver carbonate can be seen to be precipitating after the end point is passed. The change in e.m.f. is slightly less rapid than in the absence of carbonate, but this is easily overcome by the addition of excess barium nitrate solution as shown in Figure 4.

From the value of the solubility product of silver carbonate, it can be calculated that the carbonate in this concentration should commence to precipitate silver carbonate when $C_{Ag^+} = 1.34 \times 10$. When this concentration of silver ion is reached, the e.m.f. is calculated to be —0.27 volt. There is no sharp point on the titration curve at which carbonate starts to precipitate, but the effect is first observed in the range from —0.23 to —0.28 volt. The dilution of the solution to 600 ml. assists not only the first end point but also the second in that the lower the concentration of carbonate, the lower the e.m.f. at which silver carbonate precipitates.

On the whole, carbonate has no appreciable effect on both stages of the titration when present in moderate quantities, and even this slight effect can be removed by the addition of excess barium nitrate and dilution of the solution to about 600 ml. If no barium nitrate is added, it is advisable to have the interposed e.m.f. slightly lower—i.e., 0.19 to 0.21 volt.

Chloride. The effect of chloride is slightly more marked than carbonate. Owing to the lower solubility of silver chloride, it commences to precipitate at a higher e.m.f. and lower silver concentration.

Figure 5 shows the effect of adding 10 ml. and 2 ml. of 0.1 sodium chloride to the 20-ml. aliquot of potassium cyanide. This is equivalent to concentrations of 0.033 *N* and 0.01 *N* in the electroplating solution, and after dilution to 600 ml. the concentrations of chloride ion are 0.0013 and 0.00033 *N*. At these concentrations the solubility product of silver chloride is exceeded when $C_{Ag^+} = 9.$ $\times 10^{-8}$ and 4.68×10^{-7}, respectively. Using the equation for the

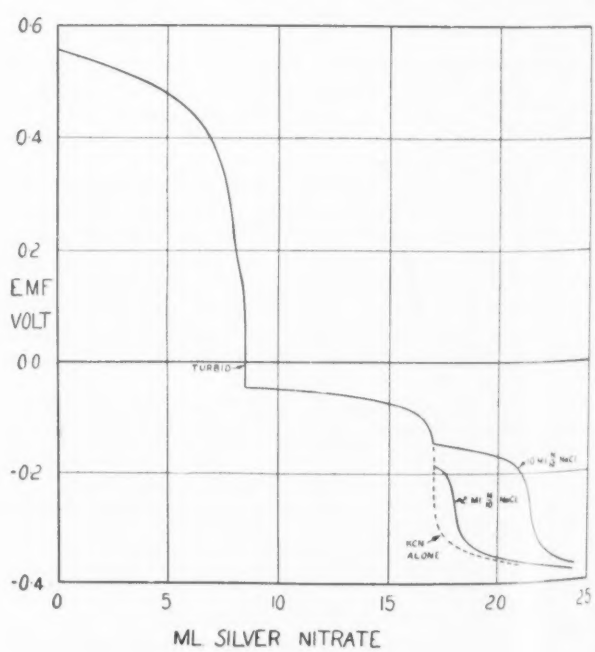


Figure 5

ver electrode $E = 0.80 + 0.058 \log_{10} C_{Ag^+}$, it can be calculated that precipitation should commence at e.m.f. of —0.14 and —0.18 volt ainst the saturated calomel electrode. It is seen from Figure 5 at the precipitation is observed to commence at —0.15 and —0.19 lt. The point of inflection of the curves indicates the complete cipitation of silver chloride and the difference between these end ints and the cyanide end point is almost exactly equivalent to the ount of chloride present; 10 ml. of the sodium chloride are equiva- nt to 4.63 ml. of silver nitrate, and the difference in end points is 5 ml. Similarly, with 2 ml. of 0.1 *N* sodium chloride, the difference 1.00 ml., the theoretical difference being 0.93 ml.

The presence of reasonably small concentrations of chloride ion the solution should not have any marked effect on the cyanide imation. If the point at which the silver chloride starts to pre- itate is taken as the end point, with 10 ml. of 0.1 *N* sodium chloride sent the error involved is only about 0.05 ml. in the titer. If loride ions can be detected in the solution, either by a potentio- tric titration or the recognized chemical methods, it is advisable use a lower e.m.f. at the end point, say 0.15 volt (according to the ount of chloride ion present). The cyanide estimation would be ghtly low, but by setting the potentiometer later to about 0.26 volt e chloride ion concentration can be determined in the same titer. The circuit as shown in Figure 2 can be used for determining the mplete titration curve. To measure any unknown e.m.f. in the cell, is only necessary to adjust the potentiometer until the galvanometer undeflected. The potential is then read off the meter.

Hydroxide. Titration curves were determined for the usual amount cyanide with 10 and 2 ml. of 0.1 *N* potassium hydroxide present. e alkali in these concentrations had practically no effect on the sults for the cyanide titration, and silver oxide did not start to cipitate until all the silver cyanide had been thrown down. There s a slight flattening of the curve below the end point, and this ppeared to be the only effect of the presence of caustic alkali.

Copper. Two titration curves were made with 2 and 5 ml. of 0.2 cupric sulfate present. Two definite end points were shown, but e rate of change of e.m.f. at the end points was much slower than ual. The presence of copper also caused a lowering of both titers an equal amount, as shown in Table III.

The reduction of the first titer can be explained quantitatively by e formation of a complex cuprocyanide. On addition of the copper lfate to the cyanide solution, a yellow-brown precipitate of cupric anide is formed instantaneously. The precipitate, however, dis- lves immediately in the excess potassium cyanide.

The reaction is probably

$$2KCN + CuSO_4 = Cu(CN)_2 + K_2SO_4$$
$$Cu(CN)_2 + KCN = KCu(CN)_3$$

It is probable that the complex loses cyanogen, forming the cupro- anide, $KCu(CN)_2$, but this does not affect the quantitative discus- on of the reaction.

The cupric sulfate solution is 0.2058 *N*, and it is seen that 3/2 oles of potassium cyanide are equivalent to one equivalent of cupric lfate. Thus, to form the potassium cuprocyanide complex, 9.17 ml. f the 0.1683 *N* potassium cyanide would be required with 5 ml. of upric sulfate present and 3.67 ml. with 2 ml. of cupric sulfate. This ould leave the amount of potassium cyanide in 10.83 and 16.33 l. unchanged. To the first end point, these would be equivalent to 62 and 6.96 ml. of silver nitrate, respectively. The actual titers btained are 4.40 and 6.94 ml. (Table III). Furthermore, titration

Table III. Effect of Copper on Titration

0.2 *N* $CuSO_4$ present, Ml.	Titer to 1st End Point	Titer to 2nd End Point	Difference of 1st and 2nd End Points
0	8.52	17.04	8.52
2	6.94	15.50	8.56
5	4.40	13.02	8.62

of 10 ml. of 0.3 *N* potassium cyanide solution with 0.1 *N* cupric sulfate equires exactly 20 ml. of cupric sulfate to the first appearance of rbidity. This corresponds exactly to the formation of the potassium uprocyanide complex by the equations given above. It is clear that he addition of copper will reduce the cyanide content of the solution, ut it does not affect the actual determination of the free cyanide emaining.

The effect of copper on the second end point is more difficult to explain. It seems that a fairly complicated series of reactions occurs. At first a white precipitate, which contains copper, is formed. After the fluctuation in e.m.f., the precipitate starts to go brown on further addition of silver nitrate. This is due to a reaction of the precipitate and silver nitrate, for it does not occur if the precipitate is removed by filtration at the end point. Both the precipitate and supernatant liquid at the point of maximum fluctuation of e.m.f. are shown to contain copper. It seems that the only reaction which could possibly fit the experimental data is one in which the cuprocyanide complex reacts with silver nitrate during the second stage of the titration in the following manner:

$$2KCu(CN)_2 + 3AgNO_3 =$$
$$2KNO_3 + Ag_2(CN)_2\downarrow + AgCu(CN)_2\downarrow + CuNO_3$$

Assuming this reaction, the difference between first and second end points would be 8.3 ml. (actually 8.62) when 5 ml. of 0.2 *N* cupric sulfate are present. There is no certainty that this is the correct reaction involved, but of all possible simple reactions it gives values nearest the observed results. The true reaction is probably more complicated. However, the presence of appreciable quantities of copper will have a marked effect on the second end point in the titration. Small amounts of copper present, however, could probably be neglected.

Mercury. The presence of mercuric salts has much the same effect on the titers as copper salts. The effect of mercury is not considered very important, as it would be very uncommon in electroplating solutions.

Zinc. The presence of 5 ml. of 0.2 *N* zinc sulfate had no visible effect on the titration curve.

Ferrocyanide. The presence of ferrocyanide had a very slight effect on the turbidity end point. The titers were 0.05 to 0.10 ml. too high if the appearance of turbidity were taken as the end point. Taking the zero e.m.f. as end point, however, gave the correct result. The second end point was increased in an amount equivalent to the amount of ferrocyanide present assuming $Ag_4Fe(CN)_6$ is formed. Apparently the $Ag_2(CN)_2$ and $Ag_4Fe(CN)_6$ precipitate together, as there is no break in the curve after the turbidity commences. If appreciable quantities of iron are present in the solution, it usually occurs as ferrocyanide, and in order to obtain an accurate silver estimation it will be necessary to know the amount of ferrocyanide ion present and make the necessary deduction from the titer. There are methods described in the literature (5) for the estimation of iron in such solutions.

Table IV. Titration of Solutions

Conditions of Titration	Titers: 1st end point *Ml.*	Titers: 2nd end point *Ml.*	Applied E.M.F. at 2nd end point *Volt*
20 ml. aliquots of 0.3 *N* KCN solutions	15.41	30.81	0.23
	15.43	30.81	0.23
20 ml. of 0.3 *N* KCN, plus 20 ml. of *N* K_2CO_3 solution	15.45	30.85	0.19
	15.45	30.85	0.19
20 ml. of 0.3 *N* KCN, plus 20 ml. of *N* K_2CO_3, plus excess $Ba(NO_3)_2$ solution (40 ml. of 0.65 *N*)	15.47	30.90	0.23
	16.08*	32.20	0.23
10-ml. aliquots of silver plating solution after intermittent use for 15 months; CO_3^- all precipitated by excess barium nitrate	12.70	35.37	0.22
	12.72	35.35	0.22
	12.72	35.35	0.22
	Av. 12.72	35.35	

* New silver nitrate solution.

TITRATION OF SOLUTIONS, USING THE GALVANOMETER NULL POINT AS INDICATOR. As a final test of the method, several solutions were titrated, using the method described previously with series galvanometer and interposed e.m.f. at the second end point. The results are shown in Table IV.

CALCULATION OF RESULT ON UNKNOWN ELECTROPLATING SOLUTION IN TABLE IV.

Free cyanide in 10 ml. is equivalent to 12.72 ml. of 0.1911 *N* silver nitrate.

The volume of silver nitrate equivalent to the argenticyanide in the solution is equal to the titer to the second end point (35.35 ml.)

(*Concluded on page* 380)

THIS IS WASHINGTON—

By George W. Grupp
METAL FINISHING's Washington Correspondent

Baltimore-Washington Branch Plans Big 1945-1946 Season The Baltimore-Washington Branch of the American Electroplaters' Society is planning to make its 1945-1946 season the biggest and most successful in its history. Each session is to be addressed by nationally known speakers. Its October, December, February and April meetings will be held in Baltimore; and its November, January, March and May meetings will be held in Washington. Ken Huston, president of the Branch, and newly elected third vice-president of the American Electroplaters' Society, plans another "Chairman of the Month" contest this forthcoming season with an attendance prize award increased from $10.00 to $15.00. Last year the Branch increased its membership by 26, which brings it to a total of 122 as compared with 43 in 1941. This forthcoming season the Branch aims to have a monthly attendance of more than 80. In looking forward to the annual educational session and dinner dance, which is to be held in February, 1946, Ken Huston said that "it is going to be bigger and better than last February's meeting." He also said that the "proposed amendment to the constitution of the Society regarding the Research Committee, which was prepared by Tom Slattery of our Branch, was approved with very little discussion." Maurice Caplan and Ken Huston are making plans for an active campaign on behalf of the Society's Research Fund.

"From War to Peace —A Challenge" Reconversion Director John W. Snyder's report entitled "From War to Peace—A Challenge," which was submitted to President Truman on August 15, 1945, is a prompt, bold and well reasoned report on the crucial decisions which must be made to solve the problems of reconversion and peacetime production. In this report Mr. Snyder states that "the same emergencies, the same skills, the same cooperation that won the war must now be directed toward the winning of a total and stable prosperity in peace. . . . There should be no mincing of words," his report states, "the sudden termination of the major portion of war contracts will cause an immediate and large dislocation of our economy. Our nation will undergo the shock of considerable, but temporary unemployment. The severity of this shock is increased by the sudden ending of the war."

As Krug Sees The Post V-J Period Since V-J Day the War Production Board has been revocating control orders on a wholesale plan to speed up peacetime production and reconversion. In fact less than 40 of the original 650 WPB control orders remain in force. In commenting on the immediate lifting of all unnecessary and obsolete controls, Chairman Julius A. Krug of the WPB, at a recent press conference said that "the removal of all WPB controls must be integrated in an orderly fashion with the actions of Government agencies responsible for other parts of the general demobilization program. For most things," continued Mr. Krug, "we will have materials running out of our ears. The important thing is to have industry moving fast enough to use up these materials. We don't want plants holding up their production because they think there won't be materials to use." Inventory controls, he said, should be continued "until the danger of hoarding, preemptive buying and stockpiling by the few at the expense of the many is over." He stated that priority ratings would be retained for the present; the preferential protection of small business, firms doing an annual business of $200,000 or less, will be continued; and the WPB will continue to use its powers to break bottlenecks. The "master plan" program report which Mr. Krug issued at this press conference states that "the immediate post V-J Day Period will be marked by a great release of manpower and other resources, but also by a number of material shortages of varying degrees of intensity."

Over 6,000,000 Unemployed By December WMC Predicts The War Manpower Commission estimates that more than 6,000,000 will be unemployed by December, 1945. It predicts that employment will drop from 7,900,000 to 4,100,000 in the metal-chemical-rubber industries; from 1,100,000 to 100,000 in ordnance manufacturing; from 1,300,000 to 200,000 in the aircraft industry; from 1,100,000 to 500,000 in the shipbuilding industry, and from 1,600,000 to 1,200,000 in Governmental war agencies.

$44,000,000,000 in War Contract Terminations Must Be Settled Director Robert H. Hinckley, of the Office of Contract Settlement, stated on August 15, 1945, that V-J Day will bring a mass termination of about $30,000,000,000 in contracts. This amount added to the backlog of $14,000,000,000 will bring the total to $44,000,000,000 of terminated contracts which should be settled with despatch. To bring this about the various contracting agencies have trained staffs totaling more than 18,000.

Bowles Discusses Post-War Price Control In a nation-wide broadcast on August 15, 1945, Administrator Chester Bowles of the Office of Price Administration said: "Price controls are going to be as important in helping us during the transition as they were during the war. . . . Because the inflationary pressures will push hardest against goods that have been off the market all during the war, we've got to see that automobiles, refrigerators, radios, and things of that sort, come back into the stores at about the same prices they went out of production in 1942. . . . While the OPA will do everything it can to head off another disastrous period of boom and collapse, we are also going to cut the red tape and end every unnecessary control as soon as possible. For example, price control will soon be taken off some of the things which don't really affect the cost of living for most of us one way or another."

"Impact of Reconversion Policies On Small Business" Senator James E. Murray's Senate Small Business Committee, issued on July 30, 1945, an interesting report entitled "Impact of Reconversion on Small Business." This report expresses the belief that "unplanned reconversion" is about to become a mad scramble for materials which will threaten the continued existence of small business and the security of 9,000,000 workers. The report recommends that "(1) That Priorities Regulation Nos. 27 and 29 be amended so as to provide preference rating assistance to firms doing less than a stated amount of business each quarter after October 1, 1945; (2) That reconsideration be given to increasing the $50,000 limit in Priorities Regulation No. 27 to $100,000 in order to increase the number of firms which are eligible to use it; (3) That special consideration be given to applying the dollar volume limit on use of Priorities Regulation No. 27 to a firm's civilian business only, in order

that smaller firms which are still partially engaged in war work will be able to use the assistance which it offers to resume civilian goods production on a partial basis; (4) That the statement of policy contained in Priorities Regulation No. 28 be modified to show that the War Production Board will grant preference-rating assistance to smaller firms which need one or two components to resume civilian goods manufacture and not only in the 'very exceptional cases' to which it now applies; (5) That every effort be made to broaden and strengthen the War Production Board's inventory control enforcement so that larger firms will not tend to indulge in preemptive buying now that the war in Europe is over; (6) That the War Production Board continue to observe the operation of manpower controls as they apply to raw material producers, and that the War Production Board, in conjunction with War Manpower Commission, investigate the possibility of removing all manpower controls over producers of basic raw materials even in areas where manpower is in critical supply; (7) That the War Production Board make every effort to bring about the prompt conversion of Government-owned steel plants to the manufacture of types of steel which is suitable for the production of civilian-type goods; (8) That the War Production Board adopt a definite policy setting a proportionate share of basic materials and parts for the exclusive use of smaller business concerns, based on previous usage of such materials by individual small plants."

"Full Employment And the National Budget" Anyone who is interested in the Murray Full Employment Bill, Senate 380, should get a copy of Report No. 2-417, "Full Employment and the National Budget," issued by the Citizens National Committee, Inc., 2633 Sixteenth Street, N.W., Washington 9, D. C. This report gives a summary of the bill, a discussion on budget recommendations, and statements by Senators Murray and Taft. In its conclusion it questions the five assumptions on which the bill is based.

WPB Estimates Minimum Peacetime Production The War Production Board, on July 26, 1945, issued some statistical tables on the present production and estimated peacetime production of over 70 different classes of items. It estimates that the grand total present production per calendar quarter of these items amounts to $4,434,370,600 as compared with the estimated "all out" or capacity peacetime production rate of $2,725,819,000 per calendar quarter, and with $1,453,908,000 as the minimum or break-even rate of peacetime production of those items. The Board estimates that the minimum or break-even rate of peacetime production per calendar quarter must be $1,375,000 for band instruments, $4,400,000 for cooking utensils, $8,000,000 for domestic vacuum cleaners, $4,975,000 for flatware, $4,000,000 for metal flashlight cases, $4,950,000 for metal household furniture, $8,200,000 for metal office furniture, $3,750,000 for metal vaults and caskets, and $9,717,000 for now-jeweled watches.

WPB Issued a "MM" Rating Regulation A new regulation, Priorities Regulation No. 30, was issued on July 30, 1945, to establish a method by which the War Production Board will assign the new military MM ratings directly to some manufacturers. Manufacturers who have ratings assigned directly to them by WPB, as has been the practice under the Controlled Materials Plan and Priorities Regulation 11-B under the new system are expected to get the production materials they need in 1946 for military orders by extending their customers' MM ratings. Where the WPB is satisfied that these manufacturers cannot practically get their production materials this way, it will assign to them directly an MM "rating percentage" indicating the percentage of their orders for production materials that they may rate as MM.

Commerce Department Expects $9,000,000,000 Industrial Expansion According to the Department of Commerce, American manufacturers are planning to undertake a $9,000,000,000 expansion program for new plants and equipment and for working capital during the forthcoming 12 months. According to the Department's study about $1,500,000,000 will be for plants, equipment and alterations, $2,800,000,000 for increasing inventories of non-military goods, and $1,900,000,000 for increasing trade receivables. All of this should stimulate some new business for the metal finishing and organic finishing industries.

Engineering Standards Conference to Be Held in Ottawa The Combined Production and Resources Board is planning a conference between United States, Canada and Great Britain on the unification of engineering standards and practices at Ottawa, Canada, on September 24, 1945. The CPRB cautioned that the development and acceptance of common standards will take time. And the conference is not being held for the purpose of seeking immediate and complete scrapping of plants, equipment and stockpiles, which would cause widespread disruption in industry.

Technical Experts Go to Germany to Study Scientific Secrets More than 200 American technical experts are now in Europe investigating Germany's technical industrial war secrets under the direction of the Joint Chiefs of Staff and in conjunction with the Foreign Economic Administration and other Government agencies. Among these technical experts are Ray H. Boundy of the Dow Chemical Co.; Verne C. Bidlack of the McCloskey Varnish Co.; Thomas S. Nichols of the Payson Paint and Varnish Co.; James H. Williams of the American Cyanamid Co.; Fred L. Wolf of the Ajax Metal Co.; Albert J. Phillips of the American Smelting and Refining Co.; Carl M. Loeb of the Climax Molybdenum Co.; Joseph D. Hanawalt of the Dow Chemical Co.; Bingen Egeberg of the International Silver Co.

Class B Producers' Materials Restrictions Eased Interpretation 34 to CMP Regulation 1, issued on July 28, 1945, provides that a manufacturer who desires to produce a Class B product under the Controlled Materials Plan need not file an application on Form CMP-4B for an allotment of controlled materials or an authorized production schedule for the product. He may now obtain his materials without the use of ratings or allotments or by extending his customers' ratings to get non-controlled materials.

SWPC May Become Peacetime Agency The Smaller War Plants Corporation may become a permanent Government agency for Senator Tom Stewart of Tennessee has introduced a bill which provides that the SWPC should be renamed the "Small Business Corporation" and that it shall make loans to small businessmen for peacetime enterprises up to $250,000 for an individual firm. The bill also provides that the agency shall be authorized to insure banks or trust companies against loss in excess of 10 per cent sustained in loaning money to small business. The Corporation would have an aggregate liability, as an insurer, not to exceed $10,000,000.

How to Do Business With RFC All those of the metal finishing industry who desire to buy some surplus equipment or materials should apply at the nearest regional office of the Reconstruction Finance Corporation and secure a copy of an informative little booklet entitled: "How To Do Business With RFC."

Aluminum Restrictions Eased Manufacturers who use comparatively small amounts of aluminum have been relieved of restrictions on their inventories of all forms and shapes of aluminum except extrusions and foil, according to Direction 25 to Controlled Material Plan Regulation No. 2, issued on July 24, 1945.

Chromic Acid Continues Critically Short Officials of the War Production Board, on July 21, 1945, expressed the opinion that there will be no relaxation of control of chromic acid because of the critical shortage of this chemical. They stated that as a result of changed military specifications or of war contract terminations, a limited group of plating and anodizing solutions containing chromic acid is not being utilized. These solutions may not be used without specific WPB authorization, because they were originally allocated under Schedule 62

(Primary Chromium Chemicals) of the general chemicals allocation order M-300. To obtain authorization to utilize such available solutions, application should be made to the Chemicals Bureau.

Single Authorization For Series of Shipments Now Permitted The Chemicals Bureau of the War Production Board explained on August 1, 1945, that shipments of consignment of chemicals controlled by the general chemicals allocation order M-300 are not permitted unless WPB authorization is received. The Bureau said that a single authorization may be obtained to cover a series of shipments by sending a letter of request to the Chemicals Bureau, WPB, Washington 25, D. C.

Revised Critical Materials List Issued By WPB On July 28, 1945, the War Production Board issued a revised list of critical materials and products which was compiled by the Joint Army, Navy and War Production Board Committee on Critical Materials and Products. On the critical materials and products list are given such items as antimony, benzyl benzoate, bismuth, cadmium, capacitors, corundum primary grade, hydrogen peroxide, laboratory equipment, lead, fractional horsepower electric motors, platinum, phthalic anhydride, rosin, sodium bichromate, tin, and microcrystalline wax. On the Surveillance List are such items as aluminum extrusions, antimony oxide, benzene, cresols and cresylic acid, chrome metal, graphite electrodes, naphthalene, naphthenic acid, nickel, paraffin wax, zinc, and zinc oxide.

56,000,000 Pieces of Flatware to Be Produced in Third Quarter of 1945 According to the War Production Board, during the third quarter of 1945, there will be produced 1,440,000 galvanized garbage cans, 3,000,000 galvanized pails, 46,000,000 pieces of flatware with priorities assistance, 10,000,000 pieces of flatware without priorities assistance, and about $6,000,000 worth of enamel ware.

Laboratory Equipment Will Ease Up Modern warfare created a demand for laboratory equipment far beyond the normal capacity of the laboratory equipment industry. Now that the war is over many items which were once in critical demand will slacken so that more will be available for civilian use.

Molybdenum No Longer Restricted The easing of military requirements made it possible for WPB to revoke Orders M-369 and M-369a on July 24, 1945, so that there is now no restrictions on molybdenum and tungsten.

Copper May Be Had From RCF Refined copper may now be purchased by all eligible buyers without certification, preference rating, or authorization number from the Reconstruction Finance Corp.

Nickel and Nickel Chemicals Directive Issued Directive No. 8 to Order M-21, issued on August 16, 1945, states that specific authorization must be obtained from the War Production Board before anyone is permitted to melt nickel on rated or unrated orders. The Direction also states that suppliers of nickel chemicals must report their schedules of delivery, production and stocks on revised Form WPB-2872. It provides further, that "Producers and dealers in refined nickel salts may deliver refined nickel sulphate and refined nickel chloride in any one month on unrated orders only after filling rated orders for delivery in that month and after accumulating a stock for use on 'emergency orders' in an amount equal to one-third of Second Quarter 1945 deliveries." Consumers of primary nickel who use less than 25,000 pounds per month do not have to report the usual desired information asked for on revised Form WPB-2871; and suppliers of nickel chemicals who fill orders for less than 100 pounds need not report such deliveries separately but may group them in reporting on revised Form WPB-2872.

Potassium Carbonate Allocation Recommended For Revocation At the August meeting of the Potassium Carbonate Industry Advisory Committee the members recommended the revocation of allocation controls on potassium carbonate because of the current supply of this material.

Service Contract Price Adjustment Amendment Issued Amendment No. 1 to Revised Supplementary Order 9, was issued on July 27, 1945, by the Office of Price Administration to offer maximum relief permissible under OPA standards for services, such as metal finishing, . . . "service essential to the war program." This amendment makes it possible for a contractor or subcontractor to make application for an adjustment of prices under his contract.

WPB Aids Small Producers Interpretation 1 to Priorities Regulation 27, issued on July 26, 1945, states that the regulation permits a manufacturer to use its procedures to obtain controlled materials or other production materials up to December 31, 1945, "if total production is not expected to be more than $50,000 worth of all products manufactured in any calendar quarter in which materials purchased under this regulation will be used."

ANALYSIS OF SILVER PLATING SOLUTIONS

(Concluded from page 377)

less twice the free cyanide titer (2×12.72 ml.). Therefore argenticyanide is equivalent to 9.91 ml. of 0.1911 *N* silver nitrate.

As the solution is made up of silver cyanide and potassium cyanide the results are expressed as such:

KCN (uncombined) = 0.2432 *N* = 31.65 grams per liter
Silver as $Ag_2(CN)_2$ = 0.1893 *N* = 25.35 grams per liter
Silver as $KAg(CN)_2$ = 0.1893 *N* = 37.67 grams per liter

Occasionally in titrating these unknown solutions it is noticed that the e.m.f. is 10 or 20 millivolt above zero at the first end point. This is possibly due to high carbonate concentration, and the effect can be overcome by putting an e.m.f. of 10 to 20 millivolt in the circuit in the appropriate direction.

Conclusions

The estimation of free cyanide and argenticyanide in a silver plating solution can both be carried out in the one titration, using electrometric methods to detect the Liebig end point and the point of complete precipitation of silver cyanide. It has been shown that zinc, chloride, hydroxide, and carbonate show no appreciable interference with the method. The presence of copper, iron, and mercury however, can have quantitative effects on titration to the second end point. These impurities are normally never present except in very small concentration and do not really militate against the method of analysis.

It is important to note that the presence of chloride can be detected quantitatively by continuing the titration after the cyanide end point. The effect of ferrocyanide—probably the commonest heavy metal impurity—can be shown quantitatively and allowed for if the iron content is known accurately.

The accuracy of the electrometric method is much in excess of that usually required for electroplating solution analysis, and the sensitivity of the end point is much less than one drop (0.05 ml.) of 0.2 *N* silver nitrate.

Literature Cited

(1) Cavanagh, B., *J. Chem. Soc.*, **142**, 2207 (1927).
(2) Gregory, J. N., *J. Council Sci. Ind. Research*, **16**, 185 (1943).
(3) Müller, E., and Lauterbach, H., *Z. anorg. Chem.*, 121, 178 (1922).
(4) Read, H. J., and Read, C. P., *Metal Finishing*, **39**, 612 (1941).
(5) Wick, R. M., *Bur. Standards J. Research*, **7**, 913 (1931).

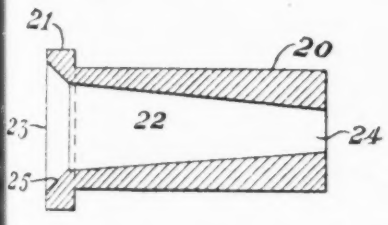
Patents

Electrolytic Pickling

U. S. Pat. 2,378,761. F. Forsberg, assignor to The American Steel & Wire Co., June 19, 1945. In the art of electrolytically treating metal in a bath including molten sodium compound, the method comprising the use of a ferrous kettle for the bath and the inclusion of a nitrogen and oxygen containing compound by the bath having the characteristic of evolving nitrogen-oxides at the anode when in an electrolytic circuit, in conjunction with passing the current from the kettle through the bath to the metal being treated in the latter, whereby the kettle is the anode, the current causing evolutions of nitrogen-oxides at the surfaces of the kettle contacted by the bath, to prevent sludges from sticking to these surfaces and making cleaning of these surfaces by scraping a relatively simple proposition.

Sandblasting Nozzle

U. S. Pat. 2,379,432. J. A. Heany, assignor



to Heany Industrial Ceramic Corp., July 3, 1945. A nozzle for sand blasts, oil chokes, and the like comprising a tube having inlet and outlet ends, the duct of the tube decreasing in size from the inlet to the outlet, the rate of size decrement of outlet relative to inlet being approximately two inches per foot.

Ceramic Glaze

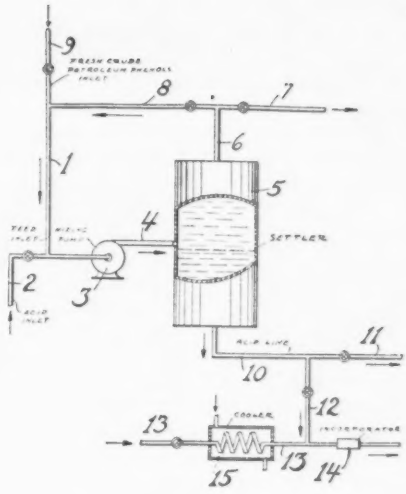
U. S. Pat. 2,379,507. A. J. Deyrup, assignor to E. I. duPont de Nemours, July 3, 1945. A ceramic composition comprising a vitrifiable glaze suspended in a medium comprising ethyl cellulose and a terpene solvent.

Cleaning Ferrous Metals

U. S. Pat. 2,380,284. J. H. Young, assignor to E. I. duPont de Nemours & Co., July 10, 1945. The method of removing impurities in the form of oxides from a ferrous metal article which comprises subjecting said article to the cleaning action of a fused bath consisting essentially of a substantially homogeneous, anhydrous, eutectic mixture of alkali metal hydroxide and alkali metal cyanide, while maintaining said bath at a temperature below 600° C.

Inhibitor for Hydrochloric Acid

U. S. Pat. 2,380,254. T. B. McCullock, assignor to Standard Oil Development Co.,



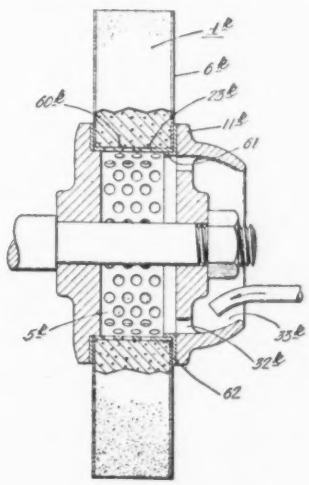
July 10, 1945. The method of inhibiting hydrochloric acid against corrosiveness to ferrous metals which comprises contacting said acid with crude phenols of petroleum origin, settling the mixture, and separating the inhibited acid from the undissolved material.

Molybdenum Black Bath

U. S. Pat. 2,380,044. R. A. Hoffman, assignor to E. I. duPont de Nemours & Co., July 10, 1945. In a process for the production of an electro-deposit, the step comprising electrodepositing an adherent, abrasion-resistant cathode deposit of an oxygen compound of molybdenum at a current density of about from 1 to 15 amperes per square foot from an aqueous acid bath including boric acid, a soluble nickel compound, and a soluble molybdenum compound selected from the group consisting of sodium molybdate, potassium molybdate, ammonium molybdate, and molybdic oxide, the amount of molybdenum present, calculated as metal, being from 7 to 150 grams per liter.

Cooling Grinding Wheels

U. S. Pat. 2,380,332. H. J. Scheer, assignor to Abrasive Co., July 10, 1945. The combination with a porous grinding wheel having a central axially extending cavity, a pair of flanges respectively gripping the opposite



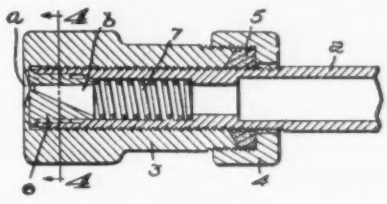
side faces of the wheel, an annular gutter formed in one of said flanges, ports affording communication between said cavity and said gutter, means for supplying a fluidic coolant to said gutter, and means within said cavity for receiving said medium from said ports and delivering it directly to definite localities throughout the full circumference and axial depth of said cavity for uniformly distributing said medium axially and circumferentially of said cavity.

Cleaning Aluminum and Magnesium

U. S. Pat. 2,381,124. J. F. Hart, assignor to Kelite Products, Inc., Aug. 7, 1945. A composition for cleaning such metals as aluminum or magnesium, which composition comprises an aqueous solution containing sodium salts of orthophosphoric acid and silicic acid in substantially the stoichiometric proportions of three mols of Na_2O per mol of P_2O_5 and one mol of Na_2O per two mols of SiO_2.

Spray Nozzle

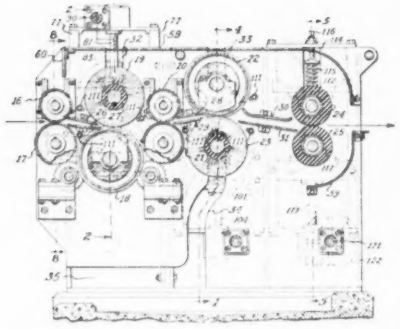
U. S. Pat. 2,380,513. H. S. Garabedian, July 31, 1945. A spray nozzle comprising a tubular body and a cap mounted thereon for relative rotative adjustment, one on the other,



around an axis extending lengthwise of said tubular body, said body having a discharge orifice in the end thereof on which said cap is mounted and said cap having a thin end wall provided with an orifice cooperating with that in said body to control the flow of liquid through the nozzle, the two orifices being eccentrically related to each other the orifice in said cap being elongated laterally and terminating at one end in a gradually tapered bevelled corner, and the cooperating edge of the orifice in said body being bevelled to cooperate with said corner in directing a fine spray at an abrupt angle laterally with reference to the axis of said body.

Sheet Cleaning Machine

U. S. Pat. 2,380,550. E. Reed, assignor to the American Rolling Mill Co., July 31, 1945. In a machine of the character described, a housing, a pair of pinch rolls, a rotary brush and an opposed supporting roll, a pair of pinch rolls, a rotary brush and an opposed supporting roll, and a pair of wiping rolls, said elements being arranged in the order named, said brushes being arranged respectively to contact upper and lower surfaces of sheet material passing through said machine, said supporting rolls being provided with magnetic means to bind the sheet material to their surfaces over areas at least as great as the areas of operation of said brushes, and means engaging the material between the pairs of rolls hereinabove set



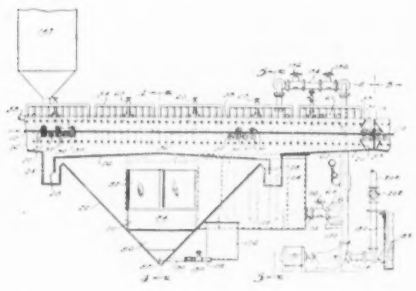
forth, said magnetic means being limited in area to release said material to said engaging means, and means for driving a roll of each of said pinch roll pairs, said supporting rolls and a roll of said wiping roll pair at the same peripheral speeds, said driving means comprising a motor and a gear drive from said motor to a roll of each of said pinch roll pairs and to one of said supporting rolls, and a second motor drive for the second of said supporting rolls, said motor drives being synchronized.

Electrolytic Polishing

U. S. Pat. 2,381,167. C. R. Horwedel and W. J. Resch, assignors to the American Steel and Wire Co. of N. J., Aug. 7, 1945. A stainless steel electrolytic polishing method comprising making the steel the anode in an electrolyte consisting of one part, by volume, of a solution of 60% chromic acid and 40% water, by weight, and from two to four parts, by volume, of a water solution of an acid of the class consisting of acetic and formic acids, the acetic acid solution consisting of 99.8% acetic and .2% water, by weight, and the formic acid solution consisting of 90% formic acid and 10% water, by weight, at a current density of from 150 to 350 amperes per square foot of anode surface and with the electrolyte temperature not exceeding 90° F.

Rustproofing Machine

U. S. Pat. 2,381,183. E. W. Richards, assignor to Parker Rust Proof Co., Aug. 7, 1945. In a method comprising the passing of metal between a succession of rolls and wetting it with a chemical solution during its passage, where the chemical solution is an acidulous one which reacts with the metal and forms insoluble salts of the acid, part of which adhere to the metal as a coating, the steps which comprise applying said chemical solution to metal as it is passed through the rolls, draining the solution from the rolls, and directing the drained solution in one path

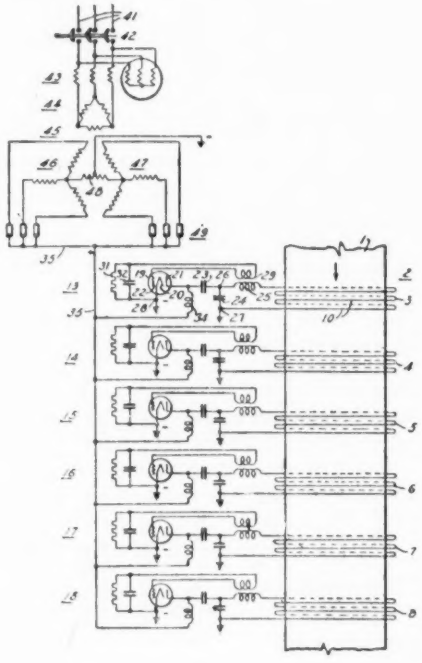


and circulating it to where it again wets metal passing through the rolls, stopping the circulation of said solution, while said circulation is stopped applying to the rolls a cleaning solution containing the same acid as, but having a lower pH than, the said chemical solution and adapted to remove sludge from the rolls, draining the cleaning solution from the rolls and directing the drained cleaning solution in a path different from the first said path.

Apparatus for chemically coating sheet metal comprising a cooperating pair of rolls through which sheet metal may be passed, nozzles in position to apply liquid to said rolls, two separate reservoirs adapted to hold different solutions, means to pump liquid alternatively from said reservoirs to and through said nozzles, a plate beneath said rolls in position to receive liquid draining therefrom, and means to direct liquid from said plate alternatively to said reservoirs.

Flowing Tin Plate

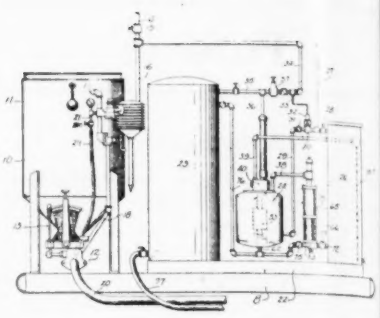
U. S. Pat. 2,381,323. M. P. Vore, assignor



to Westinghouse Electric Corp., Aug. 7, 1945. An induction-heating apparatus for inductively heating an elongated member which is continuously moving in the direction of its length.

Sand Blast Machine

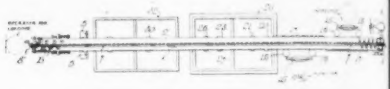
U. S. Pat. 2,380,738. A. H. Eppler, July 31, 1945. Sand blast apparatus, comprising the combination with a sand blasting generator, a mixing nozzle and a pipe connection between the generator and the nozzle, of means for metering and supplying to the mixing nozzle, under pressure, atomized liquid charged with rust resisting chemical material in predetermined quantities substantially equal to those required for coating the particles of sand generally with such material, whereby the surface to be cleaned may be coated with the chemical material simul-



taneously with the impact of the sand particles thereon.

Degreasing Machine

U. S. Pat. 2,380,968. E. W. Kimmig and F. J. Peters, assignors to Continental Can Co., Inc., Aug. 7, 1945. A degreasing ap-



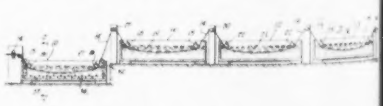
paratus comprising a tank, means for maintaining in one section of the tank a he vaporized grease-removing fluid and in as other section of said tank a liquid bath o said grease-removing fluid, and a conveying means for passing the articles to be degreased continuously and in succession through the grease-removing vapors and then into and ou of the grease-removing liquid.

Corrosion Prevention of Ferrous Articles

U. S. Pat. 2,381,778. J. M. Schoonmaker, Jr. and F. Stockton, assignors to Standard Steel Spring Co., Aug. 7, 1945. The method of protecting a ferrous article against corrosion which consists in depositing a continuous coating of nickel of substantially uniform thickness on the article, then applying to the nickel a coating of tin, and then heating at a temperature above 350° F. and below the melting point of tin for a period of time sufficient to diffuse at least a part of the tin into the outer portion only of the nickel.

Continuous Strip Pickling

U. S. Pat. 2,381,652. S. J. Dishauzi, assignor to National Steel Corp., Aug. 7, 1945. Apparatus for continuous pickling of strip metal comprising a tank for holding a body of pickling solution having a bottom, side walls and end walls, means adjacent the end walls to guide the strip metal through the body of pickling solution in the tank, a con-



duit extending along the inside of the tank jets in the conduit directed towards points in the tank along which the adjacent edges of the strip metal travels, and a source of heating fluid connected to the conduit for supplying heating fluid to the jets under pressure so that heating fluid emitted from the jets causes a stream of the pickling solution to impinge on the strip metal.

CLEAN BRIGHT BRASS CLEANER

• A new outstanding COWLES CLEANER for non-tarnishing cleaning of polished and unpolished brass, copper and bronze in still tanks with or without electric current—also in all types of washing machine equipment. Cowles K W does not attack the metal. It is fast, efficient and economical. Immediate shipment from warehouse stocks.

Cowles
TECHNICAL SERVICE on request

THE COWLES DETERGENT CO.
METAL CLEANER DEPT.
7016 EUCLID AVENUE • CLEVELAND 3, OHIO

SHOP PROBLEMS

PLATING AND FINISHING
POLISHING — BUFFING
CLEANING — PICKLING
HOT DIP FINISHES

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Equipment for Anodizing

Question: We are interested in installing anodizing. Kindly give us whatever information you can on installation of the following tanks, including size of generator or rectifier, type, etc.:

Tank 6′ x 3′ x 3′
" 12′ x 3′ x 3′
" 20′ x 3′ x 3′

G. A.

Answer: Before the size of the required electrical equipment can be furnished, it is necessary to know how much surface area is to be anodized and whether the chromic or sulfuric process is to be used.

We would suggest that you figure on the basis of 20 amps./sq. ft. for sulphuric anodizing with an 18-24 volt generator or rectifier, and 5-10 amps./sq. ft. at 40 volts for chromic acid.

Polishing of Formed Wire

Question: Problem — Fine steel wires. Wanted — a production method for polishing that will not change the shape of same.

Wire forms are approximately ⅜″ x ½″ or ¾″ in length. The wire size is .012 to .030 in diameter, depending upon the style of the traveler. Wires are turned up on both ends and are made of tempered steel.

Our present method is to scour in revolving rattlers having pockets 5″ x 15″ x 15″ using pumice about the size of coarse granulated sugar and sawdust. That gives us what we call a scour, which is a silvery material finish. The travelers are then polished in similar rattlers using scrap leather. The load in each pocket will vary from ½ pound to 3 pounds.

We are able to obtain a high polish but the fine travelers interlock with each other and in rotating pull out of shape.

We are enclosing samples of several sizes and styles.

J. L. W.

Answer: We do not know of any method which would be more suitable than the one presently employed, but we would suggest that you investigate the possibility of polishing the wire by drawing it through a sizing die before forming.

Coloring of Razor Blades

Question: We are interested in modern methods of blueing (also gilding) of razor blades, as applied in industrial production of safety razor blades from tempered steel strips.

Any data on these processes or references to related literature and patents, will be appreciated.

A. N.

Answer: The blue color is generally a heat color, produced during the tempering operation. The yellow color is usually produced either by brass plating, or by the use of dyes. We would suggest that you communicate with the Eaton-Clark Co., 1480 Franklin St., Detroit 7, Mich., for details on metal dyes.

Plating Tungsten

Question: Kindly advise if you have any information regarding tungsten plating and send us any data you may have.

S. D. L.

Answer: No process has been developed to date for depositing unalloyed tungsten. The metal can be deposited as an alloy, however, with nickel, cobalt or iron. The fluoride bath has given good results, and an example of this type of solution is:

Tungstic oxide	120 g.
Ammonium bifluoride	240 "
Sodium fluoride	240 "
Sodium chloride	240 "
Water	1 gal.

pH 5.3–6.3. Temperature 140° F.
Current Density 30 amps./sq. ft.
Anodes—Tungsten, Tungsten Carbide or Nickel.
Add small amounts of alloying metal chloride.
(H. H. Armstrong and A. B. Menefee U. S. Pat. 2,145,241.)

Alkaline baths for this purpose have also been developed, and we would refer you to the following:

Fink & Jones — Transactions Electrochemical Society, **59** (1931).
Holt — Transactions Electrochemical Society, **66** (1934) and **71** (1937).

Corrosion

Question: I have been using a standard antenna manufactured by one of the well-known radio manufacturers which has a light coat of cadmium, and on beach patrols, these antennas are subjected to salt air practically all the time, and, owing to this fact, the life of the antenna is approximately one year.

It would be greatly appreciated if you could advise me as to what plating in your opinion would stand up best under the above mentioned condition.

E. W. B.

Answer: We would suggest that you try either a heavy cadmium plate, or a heavy copper, nickel and chromium combination. The thickness of deposit should be .001" minimum for suitable life.

Wrong Reference

Question: Although we subscribe to *Metal Finishing* and receive it, we cannot locate copy of an article published in Volume 6, page 106, I believe, entitled, "Anode Racks for Chrome Plating." We would appreciate your forwarding copy of this article at your earliest convenience.

R. V. W.

Answer: We believe you have us confused with some other publication, since we are now only on our 43rd Volume.

Could you be referring to the magazine, Metal Industry, which is published in England at Dorset House, Stamford St., London S.E. 1?

French Gray Finish

Question: I wish you would please mail to me a good formula for French graying sterling silver handles without using platinum.

As you know, for a time, platinum is out, and we would like to find a substitute that will oxidize good and black.

H. C.

Answer: Immersion in any of the sulphide type oxidizing solutions will produce the French gray color. French gray, however, is not a deep black, but a gun metal finish. To produce a deep black, we would suggest that you use a black nickel plate, operating details for which will be found in the *Plating and Finishing Guidebook.*

Standard Costing

Question: We are desirous of obtaining two copies of the pamphlet or book titled, "Standard Costing of Plating Processes," by R. W. Harrison. This article was published in the "Journal of the Electrodepositors' Technical Society, **1944**, **19**, 91-105." If you cannot supply us with these copies, please advise where they may be obtained.

C. H. R.

Answer: We believe you can obtain photostats from the New York Public Library, or you may communicate with the Electrodepositors' Technical Society, Northampton Polytechnic Inst., St. John Street, London E.C. 1, England.

HAVE YOU *Checked* YOUR BRUSH REQUIREMENTS LATELY?

Keystone engineers are constantly improving their products to keep pace with the more recent requirements of higher current carrying capacity, less friction, higher speed operations and better commutation.

It is not enough for a Keystone brush to meet ordinary service. It is specifically designed and processed for the particular application on which it will serve and incorporates all recent improvements.

Keystone Brushes, because of their excellent physical properties and many hidden characteristics with exclusive features, are a decided improvement. It will pay you to check your brush requirements first and then check with Keystone.

WRITE FOR CATALOG AND PRICE LIST K-15

Keystone Metal-Graphite Brushes for low voltage generator and slip ring applications assure dependable electrical energy at all times. Copper and graphite are carefully proportioned to meet the needs of the individual piece of equipment. The brushes have excellent lubricating qualities and molded-in shunts establish a perfect connection. Your order for popular types and sizes can be quickly filled.

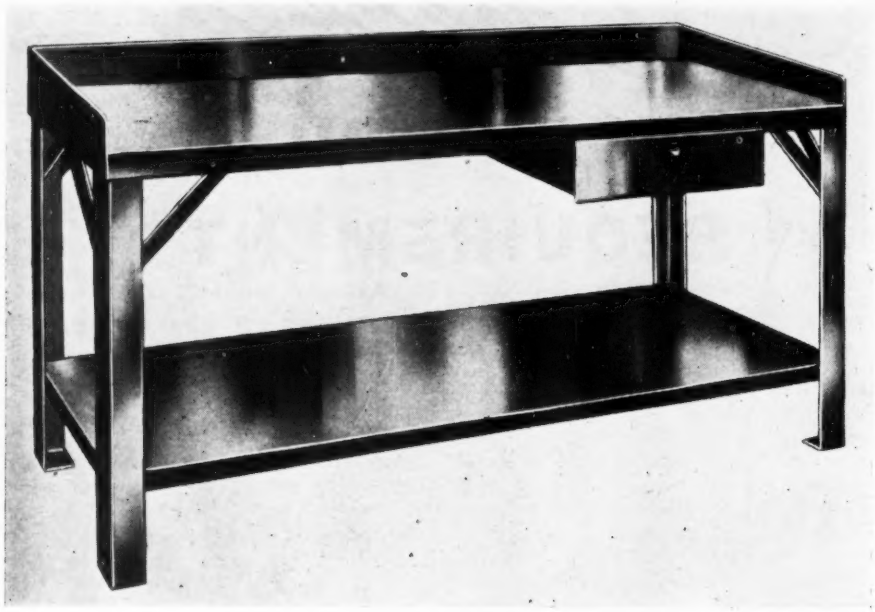
KEYSTONE CARBON COMPANY, INC.

Manufacturers of Precision Molded Products

1935 STATE STREET, SAINT MARYS, PENNA.

NEW EQUIPMENT AND SUPPLIES

NEW PROCESSES, MATERIALS AND EQUIPMENT FOR THE METAL INDUSTRY



Steel Work Bench

Streamlined design, sturdier construction, and numerous available extras, are the features of the improved Equipto 12-gauge steel work bench announced by Equipto, Division of Aurora Equipment Co., Dept. MF, Aurora, Ill. It may be furnished without back and side railings for use as a packing bench.

All four flanges of the bench are formed into a boxed edge for utmost rigidity. A second 12-gauge steel plate may be tack welded onto top for vise reinforcement. The bench is highly suitable for both work bench use and for supporting light machine tools. The four feet have holes to permit fastening to floor if desired. It is available in 42 inch and 6 foot lengths, 34 inches high and 28 inches deep, on short deliveries and without priority.

It can be furnished as a plain work bench with 12-gauge steel top and with bottom tray, back and side railings, drawers with padlock attachment, adjustable 3-compartment tray for drawer. Benches may be used side by side and back to back forming larger working surfaces in a minimum of floor space.

Micronoil Riso

Micronoil Riso is a new development in rust-inhibiting treatments for metal parts.

It is an acid-free, or neutral, oil, emulsifiable, which is added to 15 to 50 parts water, as required by the nature of the parts to be treated. It is used at a temperature of 160° F. The metal parts are immersed in the bath until they come to heat, then drained.

The illustration presents aircraft parts that have been treated with Riso and exposed for nine months to the acid fumes of a plating department. It is to be noted that the sheen of the finish still is retained. This test is claimed to have run eight months longer than was possible with any other light oil treatment tested.

Weather exposure tests of similar parts were started in October, 1944, continuing through Michigan winter conditions until March, 1945, with no visible evidence of corrosion.

Interested readers should write to *Protective Coatings, Inc.*, Box 56, Dept MF, Detroit 27, for fluid trial samples.

Cement

A new and superior resin-type cement, known as Pennsalt PRF Cement, has recently been developed by the Pennsylvania Salt Manufacturing Co. This cement is a quick-setting, cold-hardening acid, alkali and solvent proof product composed of a liquid and a powder which, when mixed, react chemically to form a cement.

Pennsalt PRF Cement has been designed specifically for bonding corrosion-proof brick and tile in uses where both acid and alkalis are encountered. Typical applications are laying floors and drains, and lining tanks in electroplating shops where a cement is required that will resist corrosive acids, alkalies and solvents.

Detailed data and instructions for use may be secured through the Special Chemicals Division of the Pennsylvania Salt Manufacturing Co., Dept. MF, Philadelphia 7, Pa.

PROFESSIONAL DIRECTORY

JOSEPH B. KUSHNER, Ch.E.
Metal Finishing Consultant
War plating plants designed and streamlined for increased production.
LA 4-9794 **233 W. 26th St.**
New York City

G. B. HOGABOOM JR. & CO.
Consulting Chemical Engineers
SALT SPRAY TESTING — CERTIFIED TO MEET ARMY AND NAVY SPECIFICATIONS. Testing of deposits-thickness, composition, porosity. Solution analyses, plant design, process development.
44 East Kinney St. **Newark 2, N. J.**

Platers Technical Service Co.
Electroplating and Chemical Engineers
Complete services, including solution analyses, process development and deposit tests.
S. C. Taormina .....Tech. Director
Dr. C. B. F. Young.....Tech. Advisor
59 E. 4th St., N. Y. C. **ORchard 4-1778**

"Electro Chemical Technology"
E. J. HINTERLEITNER AND ASSOCIATES
821 NORTH AVENUE, W.
WESTFIELD, NEW JERSEY
PHONE: WESTFIELD 2-4766
NATIONWIDE, COMPLETE CONSULTING SERVICE FOR THE METAL FINISHING INDUSTRY.
Plant Design and Layout, Production Set-Up Control and Product Testing, Cost Estimates, Etc
20 YEARS IN FIELD
MEMBER A.E.S.
RE-CONVERSION AND PREPARATION FOR PEACE-TIME PRODUCTION: — *SPECIALIZATION*

NEED HELP

WITH STEEL CLEANING OPERATIONS?

DIVERSEY *Bumper-to-Bumper* SERVICE

FOR STEEL CLEANING OPERATIONS

Here are a few typical operations where Diversey "know-how" and products can be a big help . . .

Cleaning before heat treating
Cleaning after heat treating and oil quench
Cleaning before electroplating
Cleaning prior to inspection and assembly
Cleaning before organic finishing
Removal of heat scale
Cleaning before vitreous enamelling

GET THIS *Bumper-to-Bumper* SERVICE

If you're running into trouble with any of your iron or steel treating operations, call in a Diversey D-Man for "bumper-to-bumper" service. No matter what the problem . . . and there can be plenty of them as you can see from the adjoining chart . . . the Diversey D-Man has the "know-how" plus the right tools to do the job completely from "bumper-to-bumper." By right "tools" we mean, of course, the right products. Diversey Research has devoted over 20 years to developing special-purpose cleaners, detergents, and the like.

Let the Diversey D-Man make a **cost-free survey** of *your* iron and steel treating operations. He can often show you ways to step-up production that require less man-power. Just write to Metal Industries Dept., THE DIVERSEY CORPORATION, 53 West Jackson Blvd., Chicago 4, Ill.

DIVERSEY DC-22—A vigorous, heavy duty cleaner that quickly and completely removes dirt, oil and grease from iron and steel parts. Unusual cleaning action made possible by superior saponifying, emulsifying, wetting and penetrating powers. Economical because of unusual reserve strength. A dry product used in boiling solution.

DIVERSEY DC-44—A medium duty cleaner that readily removes oil and grease from iron and steel. Rinses freely and completely, leaving no film or scale. Economical because of reserve power. Easy to use in still tank cleaning or mechanical washers.

DIVERSEY DC-16—A triple duty product used (1) as a solvent for removing oily and greasy contaminations containing solids such as buffing and polishing compounds, drawing compounds, smut and dirt; (2) as a water emulsion for use in automatic washing machines handling iron and steel parts where rust inhibition is necessary; (3) as a light-duty rust-proofing compound between fabricating operations.

DIVERSEY EVERITE—A powerful solvent specially developed to remove heat scale and rust quickly and completely without harming the sound metal. Reduces possibility of hydrogen embrittlement.

DIVERSEY DC-12—An electro-cleaner that minimizes danger of hydrogen explosions by developing limited foam blanket. Safely removes stubborn smut and dirt. An extremely efficient conductor. Economical because of long solution life.

DIVERSEY DILAC—Microscopically etches steel surfaces in preparation for painting. Imparts a rust inhibiting coating. Leaves an ideal surface for receiving and holding an organic finish.

AT YOUR SERVICE

DIVERSEY D-MAN

WITH THESE PROVEN DIVERSEY PRODUCTS

UNICHROME *

"QUICK DRY" STOP-OFF 322

Makes Your Work Easier, Faster, Better

Tight-holding, clean cutting edges that won't budge a whisker—not even for the toughest plating solutions – that's what Unichrome Stop-Off 322 gives you. This helps you do more accurate work—faster, easier. And besides, Unichrome is most convenient to use. Simply brush, spray or dip. At room temperatures, too. Another thing – it dries fast. Finally, there's no peeling or seepage with Unichrome Stop-Off 322 on the job.

Let us put you down for a trial shipment. See these advantages for yourself. There's a heavy war demand for the new and improved resins in Unichrome Stop-Off 322. But, we'll rush it to you as fast as possible. Write our nearest office for prices and complete data. *Reg. U.S. Pat. Off.

PROPERTIES

Chemical Resistance – Excellent in all plating cycles.

Application—Can be brushed, sprayed or dipped.

Drying—Dries quickly at room temperature – adheres without force drying.

Stripping – After plating, material may be removed by dissolving in Remover 322 R A.

UNITED CHROMIUM, INCORPORATED

51 East 42nd St., New York 17, N. Y. • 2751 E. Jefferson Ave., Detroit 7, Mich. • Waterbury 90, Conn.

TRY THESE OTHER UNICHROME MATERIALS

Unichrome Quick Dry Stop-Off 323—for chromium and other plating work requiring a stop-off that can be peeled off after use.

Unichrome Air-Dry Rack Coating 202 – a rack insulation that can be dipped and dried at room temperature, for use in all plating solutions.

Unichrome Coating 202 – a new rack insulation similar to Air Dry but which is force dried to obtain the extra adherence required in anodizing and hot, strongly alkaline solutions.

Unichrome Resist – a solid insulating material for constructing composite racks, stop-off shields, insulating gaskets, etc.

Dust Collector

With an extra thick, flat filter, instead of the familiar round type, Model 1150 Dustkop dust collector becomes the latest addition to the line of individual, self-contained dust collectors of Aget-Detroit Co., Dept. MF, 602 First National Bldg., Ann Arbor, Mich.

Although designed for individual use on the biggest wheel dry grinders, disc grinders, sanders, etc., as well as polishing and buffing equipment, the Model 1150 is equally adaptable to more than two wheels when the wheels are small and are grouped close together.

Being of the unit type, no duct work is required for installation so that the dust collector can be placed in operation within a very short time and without the necessity of interrupting work in the department.

Due to its compactness (20" x 36" floor space) the Model 1150 Dustkop can usually be placed behind the grinder or buffer without moving the latter. The connection between dust outlets and collector can be completed quickly with flexible metal hose or standard sheet metal pipe. With electrical connection into the starter circuit of the grinder, the installation is complete.

The Model 1150 is based on the principle of cleaning and recirculating the cleaned air back into the working space to save heat and prevent workers' complaints about drafts and the resulting colds.

Dust, dirt, and lint from the source, is drawn into the unit by a direct driven, non-clogging paddle wheel fan which is direct driven by a continuous duty 1½ hp., 3,450 r.p.m. motor. A cyclone separator contained within the unit separates most of the dust and dirt out of the air streams—the extreme fines being removed by the spun glass filter before the air is returned to the working space.

A hand crank on the end of the cabinet is for shaking the fine dust from the filter so that it can be brushed down the stack hole and into the dust collecting bin. The latter, occupying the entire bottom of the cabinet, has a dust drawer to permit easy removal and disposal of the collected dust, dirt, lint, bristles, etc.

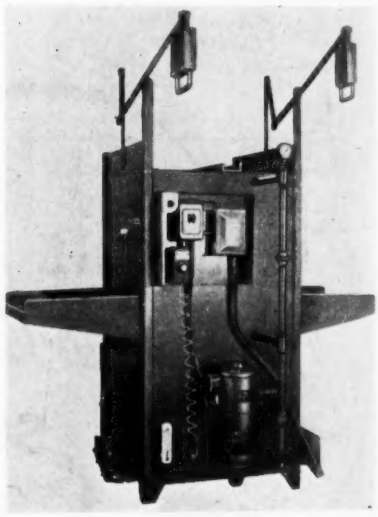
Renewal of the spun glass filter material, which is required only at infrequent intervals, is said to be inexpensive and to require only a few minutes.

The unit is available with motors for operation on virtually any type of power and can be supplied with inlet sleeves for various-sized connections to one or more dust sources.

Single Stage Washer

The new Optimus Single Stage Washer, which permits rinsing and washing in one unit, has been announced by Optimus Equipment Co., Dept. MF, 127 Church St., Matawan, N. J., manufacturers of mechanical metal washing machines and dryers.

An additional feature is the fact that the unit is portable permitting it to be easily spotted wherever the work is, eliminating the need of bringing the work to the machine. Another feature is the fact that the unit can be easily moved on to another spot as the flow of work eases on shifts from department to department.



The unit is small, compact, quick-working and handy, occupying a floor area of only 12 sq. ft. Low in cost, unit comes complete with moving jets and easy-operating vertical sliding doors that adequately control splash and spray. Unit can be equipped with any type heating device and thermostatic control.

Further information may be obtained by writing to the manufacturer at the above address.

Plastic Dip Tank

The Phillips Manufacturing Co. presents a new and improved melting tank for ethyl cellulose dip compounds that maintains critical melt with a temperature variation of less than 5° F. This efficient new unit has a capacity of 15 gallons of melted ethyl cellulose or similar compounds. Melting tank is encased in an oil bath by which heat is transmitted throughout the melt uniformly by

convection. There are no moving parts to break down—it's complete and compact to highest efficiency. Thermostatic controls keep the melt at exactly the temperature desired and there is a separate, screened off section, for adding additional unmelted ethyl cellulose so that it does not enter the melt until it, too, is of the right consistency.

This Phillips Plastic Dip Tank is all-steel, arc-welded, insulated throughout and with controls completely enclosed and protected. This is a compact trouble free melting unit for present day overseas shipping and post-war use. Your letterhead with a request will bring further details from Phillips Mfg. Co., Dept. MF, 3416 Touhy Ave., Chicago 45, Ill.

Spray Booth

Ordinary spray booths designed for paint and similar materials do not solve all the problems created by strong blasts of air and metal from metallizing guns. These difficulties are now overcome with metallizing spray booths and dust collecting equipment. Designed, engineered and built for handling sprayed metal dust, a complete line has been released by the Metallizing Engineering Co., Dept. MF, Long Island City 1, N. Y.

The Fast, Effective Method of INSULATING PLATING RACKS

MICCROTUBE on the Contact Wires

Miccrotube, the new, extruded plastic-base tubing, is quickly and easily applied to almost any type of straight or bent contact wires. Its physical characteristics provide exceptional insulating qualities, and its smooth, glossy surface minimizes dragout of solutions. Available in inside diameters from 1/16" to 1".

MICCROTAPE on the Splines

Miccrotape is an extruded tape, with tapered edges which makes it extremely easy to apply and permits much smoother overlapping and fitting into corners. It has unusual properties of dielectric strength, elasticity and tensile strength. Used in combination with Miccrotube, the two materials can be fused by heating to provide an integral coating.

A new six page bulletin provides complete information on Miccrotape and Miccrotube used both for insulation of plating racks and for masking parts prior to selective plating. Full details on physical characteristics, methods of application, and prices are included. Your copy will be mailed you immediately upon request.

MICHIGAN CHROME & CHEMICAL CO.
6348 EAST JEFFERSON • DETROIT 7, MICHIGAN

The line includes spray booths for exhausting to present exhaust systems, to the atmosphere, or into a Metco wet collector. Featured in the line is a lathe exhaust unit which is mounted directly on the lathe carriage and moves with it. Also featured are wet collectors and water wash spray booths which gather metal particles in a sludge sump where valuable dust may be reclaimed for salvage.

Metco spray booths include advantages such as sloping rear wall that eliminates eddies and recirculation . . . open type work table, down draft, dust trap and cleanout door. The complete line is described in Bulletin 43A, copies of which are available on request.

Industrial Trucks

The Market Forge Co.—makers of Materials Handling for almost a half century—has announced a new and complete line of standardized industrial trucks and accessories.

This entirely new type of industrial truck, equipped with deep stake pockets at each corner, makes possible the complete conversion of the truck from one type of load-carrier to suit other requirements simply by the addition of standard available accessories. It is now possible to set up quickly in the plant any type of truck needed to solve a load-carrying problem. To the *basic floor truck*, simply add the accessories which will make a box truck—leaf truck—shelf truck—rod and tube truck—or any one of the trucks shown in the accompanying illustration—plus many other combinations to make the truck suited to any specific need. All that is needed is the one basic type truck plus accessories.

This basic truck—designed for mass pro-

Eight Pen-Kote Masking Lacquers provide for faster, trouble-free production on *all* selective plating jobs—at appreciably lower cost. These new lacquers are regularly available for

- **HARD CHROME stop-off (four superior coatings meet every requirement).**
- **COPPER AND CADMIUM stop-off—including high-temperature copper.**
- **TIN AND ZINC stop-off—where superior resistance to high-caustic solutions is required.**
- **SILVER stop-off—a lacquer of exceptional dielectric strength in high-cyanide solutions.**

ALL Pen-Kote Masking Lacquers are easy to apply and unusually quick-drying. They adhere firmly, yet peel freely and are quickly removed after plating. They can't contaminate solutions or tarnish the work, and provide a durable, perfect protective coating of high dielectric strength.

WRITE TODAY FOR FULL DETAILS

Pen-Kote PRODUCTS

PENINSULAR CHEMICAL PRODUCTS CO.
6795 EAST NINE MILE ROAD
VAN DYKE • MICHIGAN

duction—has built-in features for safety, strength and utility. Careful design has kept weight to a minimum. Deep section channels formed in one piece with the deck provide the strong steel chassis capable of carrying up to 5,000-pound loads. Four additional channel cross members reinforce the deck.

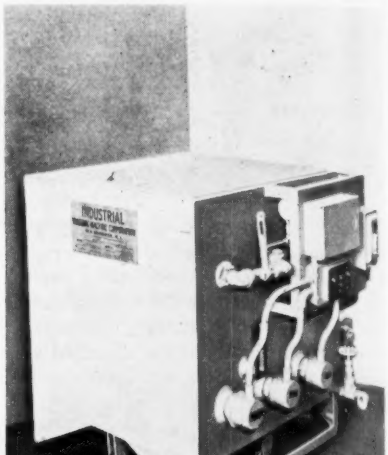
Another unique feature of the Market Forge line is the adaptability of running gear. No longer is it necessary to be handicapped with a rigid unchangeable type. The undercarriage is so designed that any one of the six caster and wheel arrangements may be adopted and readily applied for various conditions and the personal preference of the operator. Non-tilt and tilt types are easily changed, one from the other. Dolly types . . wagon types . . six wheelers . . all may be supplied at the factory, or later changed at will by the user.

12″ bull wheels and 6″ caster wheels, mounted on roller bearings and hardened shafts, are the basic running gear. Rounded corners and edges and splinter-proof deck on trucks eliminate common hazards. Automobile-type mastic material applied to the under body of the truck improves the sound deadening characteristics.

Complete story of standardized trucks and accessories is told in their Load Carrier Manual 1003MH, which can be obtained by writing to Market Forge Co., Dept. MF, Garvey Street, Everett 49, Mass.

Portable Washing Machine

The machine illustrated, manufactured by the Industrial Washing Machine Corp., Dept.



MF, New Brunswick, N. J., is known as Model C.B.H.

The unit consists of a tank and housing and is portable. Mounted on the housing are electric immersion heaters, a pump and motor, valves, switches all wired, gauges, etc.

Parts to be cleaned are placed in a square mesh basket 16″ x 16″; cover is lowered, and the spray valve turned. The force of the spray causes the basket to rotate so that all of the material is completely cleaned.

If desired, the basket can be removed and the machine is thus converted into a dip tank which can be used for wax or oil dipping of parts.

Unit can be used for cleaning stampings, ball bearings, castings, bakery pans, etc. Write for illustrated literature.

Eye Shield

A new plastic eye shield, weighing less than one ounce, has just been developed by Willson Products, Inc., Dept. MF, Reading, Pa.

Outstanding feature of the FeatherSpec is the one-piece plastic lens, gripped tightly in a new suspension-lock frame, but interchangeable or replaceable in ten seconds. A slight pull releases the lens from the grooved metal frame and makes it possible to substitute a green lens for a clear lens if the work involves glare.

It is believed that the FeatherSpec will fill the need for a safety spectacle which workers will really wear. Its light weight and attractive appearance are ideal for constant use and its low cost makes it practical to extend protection to all workers engaged in semi-hazardous occupations.

Lifting Clamp

Lifting of light or heavy plates, barrels or other containers, stampings or welded assemblies, or any metal with sufficient flat surface to enable the jaws of the Clamp to engage same, is facilitated through the use of the "Volz Flat Surface Lifting Clamp."

It picks up and securely holds, irrespective of position of the clamp when attached and lifted.

It releases instantly and automatically when the load or weight is relieved from the grip of the jaws.

It is claimed that this clamp has two definite clamping principles—one a pressure grip, the other a wedge grip—making it what is claimed an impossibility for the load or the article being held to slip, even though it contains a coating of grease or oil.

All working parts are used in a strong drop forging casing, eliminating thereby all danger of bent parts by exposure.

The cantilever basic principle actuates the one jaw—the stationary jaw being of special construction, which allows the tremendous wedge power and grip.

The entire device, from the shackle to the gripping jaws are drop forged.

They are made in four sizes—½, 1, 3 and 6 ton capacities.

They will take from 0″ to 2″ in thickness.

They are rather light in weight, comparatively, and it is claimed that every one of these clamps are individually tested prior to shipment to double their rated load. Their grip is instantaneously effected in either a horizontal or vertical position when load is applied in lifting or pulling applications.

Further information may be obtained by writing to Merrill Brothers, Dept. MF, 46-18 Arnold Ave., Maspeth, N. Y.

The 4 FREEDOMS
FREEDOM from FEAR
FREEDOM from WANT
FREEDOM of WORSHIP
FREEDOM of SPEECH
Hydro Whirl
Gives You FREEDOM from
● CLOGGED NOZZLES
● DIRTY FANS AND STACKS
● HIGH MAINTENANCE COSTS
● NESTED "Zig-Zag" ELIMINATORS
By a distinct departure from the conventional design, combined with the proved advantages of wet precipitation, Hydro-Whirl answers your problem of precipitating paint particles from the overspray in paint spraying operations.
Hydro-Whirl Dust Collectors likewise employ the same patented principle.
PETERS-DALTON Incorporated
17918 RYAN ROAD • DETROIT 12, MICHIGAN
HYDRO-WHIRL DUST COLLECTORS AND SPRAY BOOTHS—INDUSTRIAL OVENS, WASHERS AND VENTILATING SYSTEMS

Fabric Aprons

Keeping abreast with modern industry the Standard Safety Equipment Co. introduces their StaSafe Fabric Aprons with the new feature, the Snap-Strap. The application of web straps and sliding snap fasteners permits quick, positive adjustment replacing old style thongs, buckles, and other outmoded means of fastening. Workers will welcome the ease and speed with which these modern garments can be put on or taken off, providing increased efficiency and the safety of instant and automatic removal in case the apron is caught in moving machinery. The aprons are made of safety tested StaSafe Fabric in a complete line of styles and sizes in both bib and waist types. Impregnated with StaSafe Compound and cured, they protect against acids, caustics, solvents, flame, oils and paints; plus the added safety feature Snap-Straps. New literature just off the press, giving complete description, will be sent on request to Standard Safety Equipment Co., Dept. MF, 232 W. Ontario St., Chicago 10, Ill.

CONCENTRATED VALUE

Literally thousands of Master Platers are familiar with this five gallon BUNATOL container.

For more than nine years BUNATOL rack insulation has been shipped in these containers with the yellow label and each one contains perfection in rack insulation; for electro plating or anodizing racks.

BUNATOL, either the new No. 720 or the old and widely used No. 160 do represent "concentrated value" because they give every Plater more rack insulation value per dollar.

It's things like fast air drying; only a few dip coats of a single material; tough insulation that does stand up in hot cleaners and strong plating solutions; that make BUNATOL the preferred insulation for racks and fixtures.

Write for literature; find out the facts about BUNATOL—now.

NELSON J. QUINN COMPANY • TOLEDO 7, OHIO

Maintenance Paint

Designated as Pen-Kote 500, a new general-purpose maintenance paint for use in plating plants and other high-humidity applications is announced by Peninsular Chemical Products Co., Van Dyke (Detroit), Mich. This material is entirely different in composition from other maintenance paints, and offers many distinct advantages.

Pen-Kote 500 is unusually high in solids content; thus one coat often gives complete protection and two coats are sufficient under the most difficult conditions. It is as free-working as regular house paint, and can be applied by brush, dip or spray.

Surfaces to be protected need not be dry or extra-clean. On plating tanks, ductwork, etc., for example, corroded surfaces can be roughly wire-brushed, rinsed with water and painted immediately with Pen-Kote 500. Brick, wood, metal, paint and all other surfaces—wet or dry—are covered with equal ease and effectiveness. Even when applied in the most humid atmosphere, this paint dries to a hard, semi-gloss finish in 30 minutes or less. Hot surfaces are painted as readily as cold.

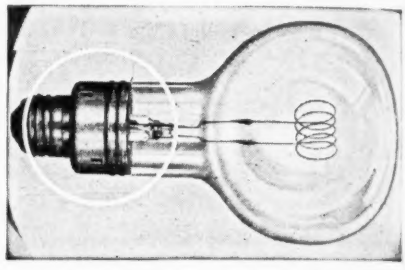
Because of these features, and because this paint is odorless, Pen-Kote 500 can be quickly applied without discomfort to plant personnel and with no shut-downs or interruption to production.

This new paint is extremely resistant to both acids and alkalis, and is highly adhesive, flexible and durable. Surfaces can be re-coated as often as desired without peeling or blistering. And previous coatings of asphalt or any other paint will not work through, for Pen-Kote 500 is an excellent non-bleeding sealer. Standard color is medium gray, and other colors are available on application.

Full information on this latest addition to the Pen-Kote line is available on request to Peninsular Chemical Products Co., Dept. MF, 6795 East Nine Mile Road, Van Dyke, Mich.

Carbon Filament Lamps

Nalco Carbon Filament Lamps are now supplied with a mechanical joint between the base and bulb, to provide a permanent seal under all circumstances. This method of mechanically locking the base to the bulb



eliminates the need for cements or other binders, and assures maximum lamp life even under the terrific heat of infra-red tunnel installations where cements tend to dry out and break down.

The clear type lamp is furnished with the mechanical base in 128, 250, 375 and 500 watts. The inside silvered R-40 lamps with mechanical base are available in 128, 250 and 375 watts.

It is to be noted that Nalco Dritherm infra-red ray lamps are of the carbon filament type which the manufacturer claims produce a higher percentage of infra-red rays in the desired Angstrom drying range.

Further information may be obtained by writing to North American Electric Lamp Co., Dept. MF, 1014 Tyler St., St. Louis 6, Mo.

"WOOL COMES FROM SHEEP, COAL COMES OUT OF THE GROUND, AND TIN COMES FROM SALVAGE CANS!"

Fundamentals of Science Relating to Electroplating

(*Continued from page 371*)

is, however, an electrical conductor, and therefore current continues to flow and, under normal conditions, continues to liberate oxygen.

Both the above examples have dealt with visible precipitates on the anode. Sometimes the compound formed is not readily visible to the naked eye, and the classical example is the nickel anode in a sulfate solution. As certain voltages above a minimum are continuously applied, an invisible film is formed which permits the current to continue to pass but which prevents the nickel from dissolving, i.e., oxygen gas is evolved. Chloride and hydrogen ions retard the formation of this film and hydroxyl ions accelerate its formation. This is the basis for some of the requirements for a good nickel plating bath. Electropolishing involves similar principles.

Platinum and carbon are other examples of anodes generally insoluble in most electrolytes. This is a useful situation, however, in many cases, where it is desired to avoid metal dissolving from an anode, to permit better control over the solution, to avoid contaminating the solution, or for other reasons.

In addition to the soluble and insoluble anodes of the metal elements, sometimes alloy anodes are used, as in some cases of gold plating and in brass plating. Since alloys may differ metallurgically in structure, the mechanism by which they dissolve or react will also vary. In general, the most negative part of the alloy dissolves in preference to the rest of the surface. The particular solution will, of course, help to determine this. Thus a knowledge of metallurgy and the composition and structure of the alloys—i.e., undissolved elements, solid solutions, intermetallic compounds, phase changes—as well as a knowledge of chemistry and electrochemistry are necessary to explain, or attempt to forecast, the action of alloy anodes in electrolytes, particularly if the latter are complex and capable of forming complex ions.

Another phenomenon associated with anode reactions occurs when anodes of different compositions are used at the same time. For example, if both steel and silver are used as anodes in a cyanide solution, the current is not necessarily distributed over each material in proportion to its area. Generally the silver takes a much larger than proportionate share of the current. Among the causes for this are the high polarization and relative passivity of iron in cyanide solutions. However, when the silver has dissolved, the iron will be attacked and this is particularly true if chlorides are present in the solution (even as drag-in from a pickling solution). Thus steel tanks used for cyanide plating solutions may corrode in some cases if they become anodic in the circuit and it is therefore preferable to leave the steel coated with its normal mill scale.

Corrosion is another manifestation of anodic reactions but this is a subject which deserves at least one chapter in its own right.

of ALUMINUM TUBING AND

All Tough METAL CLEANING PROBLEMS

When the war jolted production of aluminum tubing into high gear, one west coast manufacturer immediately called upon a Detrex Service Man to help in analyzing his degreasing problem. Aluminum tubing—vital in aircraft production—required a solvent possessing the utmost in stability. The answer—PERM-A-CLOR. Today, after a record run of more than three and a half years, PERM-A-CLOR is still being used.

Having the highest stability of any degreasing solvent, PERM-A-CLOR is right for any combination of metals.

PERM-A-CLOR and Triad are stocked in the following cities:

Akron, O.	Fort Wayne, Ind.	Portland, Ore.
Baltimore, Md.	Grand Rapids, Mich.	Providence, R. I.
Birmingham, Ala.	Houston, Tex.	Reading, Pa.
Brooklyn, N. Y.	Indianapolis, Ind.	St. Louis, Mo.
Buffalo, N. Y.	Kansas City, Mo.	Salt Lake City, Utah
Cambridge, Mass.	Lima, O.	Saginaw, Mich.
Charlotte, N. C.	Los Angeles, Cal.	San Francisco, Cal.
Chattanooga, Tenn.	Lockland, O.	Seattle, Wash.
Chicago, Ill.	Milwaukee, Wisc.	Somerville, Mass.
Charlestown, Mass.	Minneapolis, Minn.	South Bend, Ind.
Cincinnati, O.	Nashville, Tenn.	Springfield, Mass.
Cleveland, O.	New Haven, Conn.	Syracuse, N. Y.
Dallas, Tex.	Newark, N. J.	Tulsa, Okla.
Dayton, O.	Niagara Falls, N. Y.	Toledo, O.
Denver, Colo.	Oakland, Cal.	Waterbury, Conn.
Detroit, Mich.	Philadelphia, Pa.	Worcester, Mass.
El Monte, Cal.	Pittsburgh, Pa.	

INVEST IN WAR BONDS

DETREX Corporation

13009 HILLVIEW AVE. • MICHIGAN

Solvent Degreasers • Metal Parts Washers • Processing Equipment • Industrial Cleaning Compounds

Now! Projection Welding of Two Studs to Housing in One Operation!

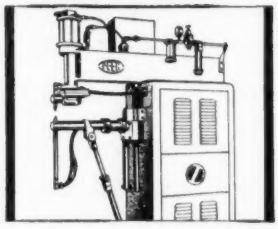
The series of P-20 Peer Welders were developed to provide manufacturers of sheet metal and wire products with automatically air operated machines capable of high speed precision projection and general spot welding. They are sturdily constructed, low priced, direct air operated, press type machines.

Shown above, is a Peer P-20 set up with safety guard which is so adjusted that, when lowered, it trips the switch and causes the welder to pass through a complete welding cycle before the machine automatically lifts the guard and stops, ready for the next operation. Other means such as a foot-switch control, can also be used to actuate the welding cycle.

The standard cylinders furnished with these welders provide nominal electrode force up to a maximum of 1000 lbs. Pressures are easily adjusted by the air pressure regulating valve. The welders may be operated with strokes suitable for work at hand within the range of from 0" to 3".

Shown at right, is the wrapper from a package of Wrigley's Spearmint Gum. This famous wrapper will remain empty until conditions permit Wrigley's Spearmint manufacture in quality and quantity for everyone. Wrigley's Spearmint Gum, will, one day, be back as "a help on the job" to workers in industry. Until then, we ask you to remember this wrapper as a guarantee of finest quality and flavor in chewing gum!

You can get complete information from Pier Equipment Mfg. Co., 8 Milton St., Benton Harbor, Mich.



Air Operated Press Type Spot Welder

Remember this wrapper

Z-82

Technical Literature

Cast Iron in the Chemical and Process Industries

Extensive data on the corrosion rates of cast iron exposed to the action of substances commonly handled by chemical structures feature a pamphlet, entitled "*Cast Iron in the Chemical and Process Industries*," recently published by the *Gray Iron Founders' Society*, national association of manufacturers of engineering gray irons. It is the work of *F. L. LaQue*, head of the corrosion engineering section of the *International Nickel Co., Inc.*

Results of laboratory and plant tests with more than 300 corrosive media in an alphabetical range from acetic acid to zinc sulfate are shown. The four appended tables also list the many chemicals regularly handled by the cast iron pumps and valves and those resisted satisfactorily by high silicon irons.

Factors dictating cast irons for corrosive service, the availability of the material, design for chemical industry equipment and many specific applications are discussed in the text of the 28-page publication. Pointing to the corrosive-service-per-dollar factor, the booklet states that in some applications the nature of the corrosive media is such that, despite a fairly rapid attack on cast iron, no other material can be expected to render long enough service to justify a higher initial cost.

Differences in the manner in which cast iron resists corrosion, the pamphlet notes, are related directly to the structure of the material and, particularly, to the presence of graphite flakes in a ferritic, pearlitic, or austenitic matrix. The corrosion resisting characteristics of gray iron may be altered by alloying and by foundry techniques since both affect the size, shape and distribution of the graphite particles and influence the corrodibility of the matrix.

The pamphlet is available at $1 per copy from the Society's Cleveland or Washington offices.

Research Catalogue

A 72-page catalogue of the publications and patents which have resulted from fifteen years of fundamental and applied Battelle research has just been published by *Battelle Memorial Institute*, Columbus, Ohio.

Founded to advance education, science, and industry through research and through the dissemination of technological information, Battelle has published widely in the nation's technical and scientific journals. The new catalogue lists more than eight hundred such journal contributions, books, and patents between the years 1929-1944, inclusive.

The catalogue includes subjects in the fields of organic chemistry, electrochemistry, chemical engineering, graphic arts, welding technology, applied mechanics, mineral dressing, industrial physics, ceramics, fuels, and metallurgy.

Copies may be obtained by writing to the Battelle Memorial Institute, Dept. MF, Columbus 1, Ohio.

Porcelain Enamel

A colorful new booklet, describing many of the characteristics and applications for porcelain enamel, has been issued by the *Porcelain Enamel Institute* of Washington, D. C. It includes a pictorial description of how porcelain enamel is made and applied to metal parts.

Many of the ways in which porcelain enamel improves the appearance and service of household, commercial and industrial products are fully covered in the new booklet. It points out the attractive appearance, cleanliness and durability of porcelain enamel finishes in all these fields. The information given is of interest to engineers, designers and manufacturing and sales executives.

The dependable protection provided by porcelain enamel against abrasion, corrosion, heat and dirt makes it ideal for use in industrial plants, according to the Porcelain Enamel Institute.

Advice as to proper design and procedure in obtaining best results from porcelain enamel is also contained in the new booklet, which may be obtained from this publication or by writing direct to the Porcelain Enamel Institute, Inc., Dept. MF, 1010 Vermont Ave., N.W., Washington 5, D. C.

Business Items

Joseph T. Sullivan

MacDermid Inc. announces the appointment of *Mr. Joseph T. Sullivan* as technical sales representative for Northern Massachusetts, Maine, Vermont, and New Hampshire.

Mr. Sullivan is a graduate of Yale Engineering School, where he received his B. S. degree in Metallurgy in 1934. In 1935 he joined the New Haven Clock Co. as assistant chemist in their laboratory and subsequently was made chief chemist in charge of all metal finishing departments.

Mr. Sullivan is a member and past president of the New Haven branch of the *American Electroplaters' Society.*

Miriam Lauren, formerly of the Rockefeller Institute for Medical Research, has joined the staff of *Foster D. Snell, Inc.*, where she will have charge of a greatly enlarged micro-analytical laboratory. Mrs. Lauren is a graduate of Barnard College and holds her M. A. degree from Cornell University Medical School. She is a member of Phi Beta Kappa. The micro-analytical facilities of Foster D. Snell, Inc., are being enlarged at this time to meet increased demands for this type of work by the firm's industrial clients.

Gerald M. Compeau, recently research analytical chemist with the Colgate-Palmolive Peet Co., has also joined the staff of Foster D. Snell, Inc. Mr. Compeau, who is a graduate of Rutgers University, has been appointed assistant to the director of the analytical laboratory.

The *Dow Chemical Co.* announce the addition of *James V. Winkler* to their Los Angeles staff as development engineer for magnesium on the West Coast. Mr. Winkler was formerly in charge of experimental engineering at Dow's magnesium fabrication laboratory in Bay City, Mich. A graduate of the University of Michigan, he has been with the company four years, and is well qualified to give technical aid to manufacturers who are fabricating and using magnesium.

Provides extra stamina for severe plating cycles

Extremely corrosive solutions, anodizing baths and severe cycles need not shorten the useful life of your racks. Not, if you switch-over to Unichrome coating 202. That's because it is compounded of special, improved resins that give it utmost chemical resistance, unusual toughness and superior adherence. And, force drying for which it was developed fortifies these desirable qualities.

Hard-to-get as these resins are today, no substitutions have been made in our formula. So you can start your racks toward a longer, more profitable life, by ordering a trial shipment now. Our nearest office will gladly give you information and prices.

*Trade Mark Reg. U.S. Pat. Off.

PROPERTIES

Chemical Resistance—Excellent for all plating cycles.

Toughness—Withstands repeated flexing and shop handling — cuts cleanly and easily at contacts.

Drying—Dipped at room temperature in container in which it is shipped — force dried at 200°F. for extra protection.

Adherence — Excellent for severe cycles. For moderate cycles Air-Dry coating is recommended.

UNITED CHROMIUM, INCORPORATED

51 East 42nd St., New York 17, N.Y. • 2751 E. Jefferson Ave., Detroit 7, Mich. • Waterbury 90, Conn.

TRY THESE OTHER UNICHROME MATERIALS

Unichrome Air-Dry Rack Coating 203—a rack insulation that can be dipped and dried at room temperature, for use in all plating solutions.

Unichrome Quick Dry Stop-Off 322—for cyanide copper and other plating work requiring an extremely adherent stop-off.

Unichrome Quick Dry Stop-Off 323—for chromium and other plating work requiring a stop-off that can be peeled off after use.

Unichrome Resist — a solid insulating material for constructing composite racks, stop-off shields, insulating gaskets, etc.

Engineering activities of the parent company will be under the direction of *W. J. McGoldrick* who has been vice president in charge of Aeronautical Engineering, it was stated. Under Mr. McGoldrick will be consolidated the company's engineering activities in the domestic and industrial heating and air conditioning controls field.

A graduate of Northwestern University, where he received degrees of Bachelor of Science and Electrical Engineering, Mr. Dever joined Honeywell as a sales engineer in 1931. He was formerly employed by the Underwriters Laboratories in Chicago, the Absolute Con-Tac-Tor Corporation of Elkhart, Ind., and the Time-O-Stat Company. Both of the latter companies were merged with Minneapolis-Honeywell in 1931. In 1936 Mr. Dever was appointed branch manager in Philadelphia and was made vice president in charge of engineering in 1939. He is a member of the American Society of Heating and Ventilating Engineers.

Mr. McGoldrick joined Honeywell in 1935 as a member of the engineering department. In 1941 he was made vice president in charge of Aeronautical Engineering when Honeywell's Aero division was first formed.

The *Foxboro Co.*, Foxboro, Mass., maker of industrial instruments for measurement and control, announces the reopening of its branch office at Charlotte, N. C., closed in October, 1942, because of war conditions. *Mr. Samuel C. Alexander*, 2012 East 7th St., is the resident engineer in charge.

CLEAN-RITE
All-Purpose CLEANERS

ANODES
BLACK OXIDE SALTS
BUFFS
CHEMICALS
CLEANERS
COMPOSITIONS
ELECTROPLATING EQUIPMENT
LACQUERS
PLATING RACKS
POLISHING EQUIPMENT
POLISHING WHEELS
SOLDER FLUX
STOP OFF MATERIALS
TANKS

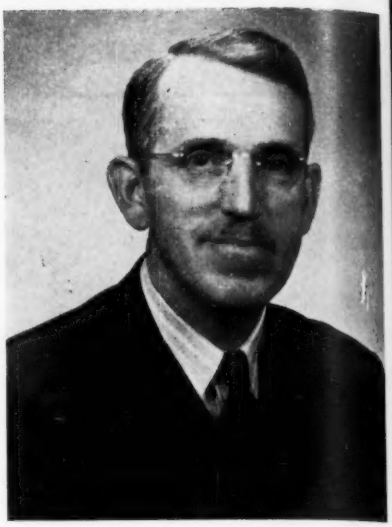
• • •

PLATING ROOM SERVICE

Let us help you solve your problems.
Take advantage of our practical experience.

JACOB HAY COMPANY
Centralized Distributors
4014 WEST PARKER AVE. CHICAGO 39, ILL.
TEL. ALBANY 2742

COMPOUNDS: Burring, Cutting Down, Polishing, Mirror Finishing.
4A CEMENT: Used for setting up Wheels, Belts, Buffs & etc.
HARRISON & COMPANY, INC., Haverhill, Massachusetts



G. E. Jackson

Kelite Products, Inc., Manufacturers of Specialized Industrial Cleaning Compounds, recently announced the promotion of *G. E. Jackson* to Regional Manager.

An old timer in the Kelite organization, Mr. Jackson is well known in Northern California and particularly in the Oakland-East Bay area, whose war as well as peace time industries he has served. He has been covering this region since before the war and is now in charge of the Kelite group in this same area.

The *Foxboro Co.*, Foxboro, Mass., maker of industrial instruments for measurement and control, announces that *Mr. Clarence Leslie Williams* has joined its staff of sales engineers whose headquarters are in the company's New York office, 420 Lexington Ave. He has been assigned to the northern New Jersey territory and has already entered upon his new duties.

Mr. Williams is thoroughly at home in this area, being a native of New Jersey and a graduate of Stevens Institute of Technology, at Hoboken. A broad background of diversified business experience has equipped him for capable and efficient assistance to Foxboro customers in any problem of industrial instrumentation.

Election of *Henry F. Dever* as president of the *Brown Instrument Co.*, a wholly-owned subsidiary of the *Minneapolis-Honeywell Regulator Co.*, was announced today by *Harold W. Sweatt*, president of the parent company.

Mr. Dever, who has been serving as vice president in charge of engineering for Minneapolis-Honeywell, succeeds *Charles B. Sweatt* as president of Brown. The latter, vice president and director of Minneapolis-Honeywell, has withdrawn from Brown and will henceforth devote his entire attention to supervision of the expanded sales activities of the Honeywell organization and its subsidiaries.

Mr. Dever will also assume the responsibilities of *E. B. Evleth*, general manager of Brown Instrument, who, because of ill health, has requested that he be relieved of his duties at an early date.

Morton I. Dorfan

Morton I. Dorfan has been appointed manager of the dust and fume engineering division of *American Foundry Equipment Co.*, Mishawaka, Ind. In this position he will supervise and coordinate the company's expanded dust control sales, engineering and research activities.

After graduation from Columbia University with the degree of Mechanical Engineer Mr. Dorfan spent several years abroad in post-graduate study. During World War I he served as Captain in the Ordnance Department. Since then he has specialized entirely in dust and fume control engineering. His previous activities in this field have been associated with Allis-Chalmers Mfg. Co., Blaw-Knox Co., and Pangborn Corp. Since 1941 he has been engaged in private consulting engineering.

Mr. Dorfan is a registered professional engineer and is a member of the American Society of Mechanical Engineers and The American Society of Heating and Ventilating Engineers.

Dr. Robert C. Gibson has recently joined the *Tanner Chemical Co.*, manufacturers of rustproofing chemicals and processes at Ferndale, Detroit, Mich.

Dr. Gibson, a resident of Birmingham, Mich., completed his undergraduate work at Adrian College and received his Ph.D. at University of Michigan. He was professor of chemistry in Ohio and later became director of research at *Parker Rust Proof Co.* from which position he resigned last April, prior to taking over his new duties.

He is considered one of the leaders in the rustproofing field and will continue his technological contributions as vice-president in charge of research for the Tanner Chemical Co.

John E. Ohlson, Ch.E., formerly wih *Wyeth, Inc.*, Philadelphia, Pa., has been appointed senior chemical engineer of the *Pennsylvania Salt Mfg. Co.*, Philadelphia, Pa., according to an announcement by *F. H. Walker*, manager of engineering.

Mr. Ohlson, a native of Panama Canal

METAL DEGREASING

PENOTRITE

√ REMOVES GREASE AND OIL FROM METAL PARTS

√ PRODUCES CLEAN PARTS READY FOR INSPECTION

√ REDUCES REJECTS BY REMOVING OIL AND GREASE FROM INACCESSIBLE PLACES

√ LOWERS RISKS OF DAMAGE TO DELICATE WORK

√ CAN BE USED ALONE OR IN PRODUCTION LINE

√ CONSUMES SMALL QUANTITIES OF SOLVENT

√ EASY TO OPERATE, CAN BE USED IN EXPENSIVE TANK EQUIPMENT

√ A TIME AND COST SAVER

√ CAN BE USED AT ROOM TEMPERATURE

√ AVAILABLE FROM MANY ACCESSIBLE WAREHOUSE STOCKS.

GENERAL SOLVENTS COMPANY
INCORPORATED

926 EXCHANGE ST. ROCHESTER, N. Y.

PERMAG
Cleaning Compounds

—will solve your new reconversion cleaning problems in all metals and their alloys.

Try PERMAG Compounds before changing your cleaning process.

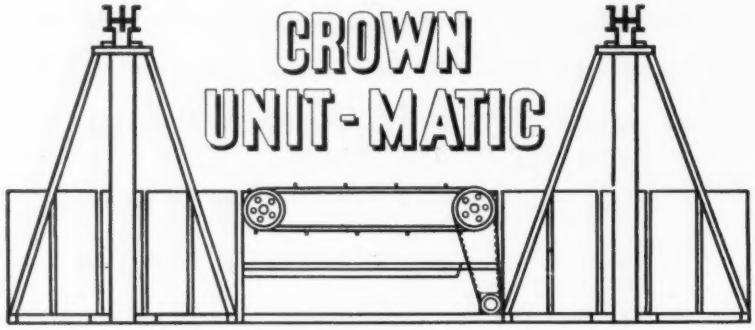
Consult our TECHNICAL SERVICE DEPARTMENT for special cleaning problems. Write us about your difficulties.

MAGNUSON PRODUCTS CORPORATION
Manufacturers of Specialized Scientific Cleaning Compounds

Main Offices: 50 Court St., Brooklyn, N. Y.
In Canada: Canadian PERMAG Products Ltd., Montreal-Toronto

Crown

BRINGS TO THE PLATING INDUSTRY THE OUTSTANDING EQUIPMENT DEVELOPMENT DURING THE PAST QUARTER OF A CENTURY



(PATENT APPLIED FOR)

FULLY AUTOMATIC
PARTIALLY AUTOMATIC
EQUIPMENT

FOR

PLATING
ANODIZING
CLEANING
PICKLING

CROWN RHEOSTAT & SUPPLY CO.
3465 N. KIMBALL AVE. CHICAGO, ILL.

A Process for Anodizing and Decorating Aluminum in Any Color

ALUMADIZING

(Reg. U. S. Patent Office)

1. **A Beautiful Decorative Finish.**
2. **Complete Corrosion Protection.**
3. **Any Color—Soft or Lustrous.**
4. **Resistant to Abrasion.**
5. **No Royalties to Pay.**

Send samples for ALUMADIZING without obligation.
Consult us on your metal finishing problems.

ALL-BRITE CHEMICAL CO.
WATERBURY 89, CONN.

John E. Ohlson

Zone, received his Master's Degree in Engineering at the University of Michigan in 1934.

Prior to his association with Wyeth, Inc., where he served as assistant to the manager of plant operations, Mr. Ohlson was connected with Niacet Chemicals Corp., Niagara Falls, N. Y., as process engineer. He is identified with the first commercial vinyl acetate plant in the United States.

The company also announces the following additions to its Research and Development staff:

Dr. C. E. Inman, formerly with Hooker Electrochemical Co.

Mr. H. S. Fisher of Aluminum Company of America.

Mr. O. T. Aepli of Attapulgus Clay Co.

Mr. E. P. Street, recent graduate of Yale University.

The *Manderscheid Co.* announces the appointment of *Lea Mfg. Co.* of Waterbury, Conn., as distributors of Presto Polishing Wheel Bushings, Semi-Automatic Tube Polishing Machines, Balance Ways and other Manderscheid Polishing Room Accessories.

"NOW ARE YOU SATISFIED THIS BOX IS STURDY ENOUGH TO PACK JACK'S OVERSEAS CHRISTMAS PARCEL IN ?"

Manufacturers' Literature

Polishing Room Accessories

Time-saving accessories that speed production and promote safety in polishing, buffing and burring are illustrated and described in the new *Manderscheid Bulletin* 102.

Items included are the Semi-Automatic Tube Polishing Machine, Balance Ways and Mandrels, Polishing Lathe Chucks and Tapered Screw Points, Polishing Lathe Collets, Wrenches, Flanges and Nuts, Polishing Wheel Balance Weights, Bushings and Reducer Bushings, Buffing Wheel Rakes, Emery Troughs and Covers.

Bulletin 102 is available on request to the Manderscheid Co., Dept. MF, 605 West Washington St., Chicago 6, Ill.

Industrial Chemicals

Pennsylvania Salt Mfg. Co., Dept. MF, 1000 Widener Bldg., Philadelphia, Pa., announces that copies of their new pocket-size booklet, "*Pennsalt Industrial Chemicals and Specialties*" are available for distribution upon request.

This descriptive booklet lists the industrial chemicals and specialties manufactured by Penn Salt under the sales division controlling them. In addition, data is included on the industries served by Penn Salt and the addresses of their district sales offices and plants.

Copies may be obtained by writing to the company.

Grinding and Finishing

A new booklet has been published by *Behr-Manning*, Troy, N. Y., presenting complete engineering and production data on the latest methods for speeding up grinding and finishing operations by conversion from abrasive set-up wheels to coated abrasive belts.

Of immediate importance to all production supervisors, tool and methods engineers and foremen, the new folder permits quick appraisal of the practicability and advisability of conversion for any particular plant or operation.

Thoroughly illustrated with typical production photographs, artists' drawings and phantom views, the new, easy reading folder demonstrates the sound engineering simplicity of the conversion principle, gives the technical explanation of belt superiority, and presents in readily understood form the specification range for the various types of backstands, contact wheels and coated abrasive belts.

Ask for folder, "*Grinding and Finishing with Idler Backstands*", Behr-Manning, Dept. MF, Troy, N. Y.

Precision Grinding and Finishing

A new 12-page booklet entitled "*Faster, Better Finishing of Metal, Plastic and Glass*," which describes the 3-M Wetordry Method of precision grinding and finishing at high

"Bright as a Silver Dollar"

. . . . and Stays that way!

Shiny, too! In short, Luster-on* bright dip for zinc-plated parts is an economical finish, available now, that gives sales appeal and a protective coating in one simple application.

Study the unretouched photograph a moment. Notice how fingermarks and white corrosion have already marred and made repulsive the ordinary zinc plating. Then see the gleaming chromium-like brilliance of the Luster-on* dipped part. No dark smudges, no age stains, no white disfigurements for Luster-on* even resists salt spray exposure!

Tools, parts and other zinc-plated articles will find their place in present and postwar markets more easily with a Luster-on* finish.

KEMO SAYS: Send us a sample of your zinc-plated items for free processing with Luster-on*. See the improvement with your own eyes.

*Patent applied for

THE Chemical CORPORATION

54 Waltham Ave., Springfield 9, Mass.

THE CHEMICAL CORPORATION
54 Waltham Ave., Springfield 9, Mass.

Please send me full particulars about Luster-on* bright dip for zinc surfaces. I am (am not) sending sample part for free dip. No obligation, of course.

Name.....

Address.....

Metal Finishing, September

The ABBOTT Method

★ TEST WORK REPORT
on your parts

PRODUCES RESULTS

TRY IT!

IT'S AN EFFICIENT METHOD OF

DEBURRING

• • •

★ TEST WORK REPORT

Send a few unfinished samples of the parts to be Deburred and get our Test Work Report . . . it's gratis and gives the facts.

THE ABBOTT BALL COMPANY 1046 NEW BRITAIN AVE. HARTFORD 10, CONN.

CHROMIC ACID

99.75% PURE

With two complete, independent plants at Jersey City and Baltimore, and its own supply of the basic raw material Chrome Ore from company owned and operated mines, Mutual is the world's foremost manufacturer of Chromic Acid.

MUTUAL CHEMICAL CO. — 1845-1945 — 100 YEARS OF CHROMIUM CHEMICAL PROGRESS

Bichromate of Soda

Bichromate of Potash

MUTUAL CHEMICAL COMPANY OF AMERICA

270 MADISON AVENUE — NEW YORK 16, N.Y.

PLATING RACKS
by JOSEPH NOVITSKY

- We specialize in plating racks of our own patent.
- Constructed without screws, rivets, solder, brazing, welding.
- We design racks to suit your individual problem.

JOSEPH NOVITSKY

Office: 104-17 199th St., Hollis 7, L. I., N. Y.
(Phone—HOllis 5-6871)

Factory: 147-24 Liberty Ave., Jamaica 4, L. I., N. Y.
(Phone—REpublic 9-7223)

speeds, has just been released by the *Minnesota Mining and Manufacturing Co.*

The booklet explains, in non-technical language, how this modern grinding and finishing method keeps operating heat at a minimum; eliminates distortion, discoloration and plastic flow; greatly increases the life of abrasive belts; eliminates the hazard created by dust when grinding glass, ceramics and certain metals.

An outstanding feature of this new booklet are the numerous illustrations showing actual industrial applications of the 3-M Wetordry Method to problems frequently encountered in grinding and finishing departments. Copies of the booklet may be obtained, free of charge, from the advertising department of the Minnesota Mining and Manufacturing Co., Dept. MF, St. Paul 6, Minn.

Electric-Type Controllers

The *Bristol Co.*, Dept. MF. Waterbury 91, Conn., has announced that a new 16-page bulletin describing their new *Micromat* and other Electric-Type Pyromaster Controllers has been published.

The several different types of controllers are illustrated and described, contact and load circuit wiring diagrams are given, and typical applications are indicated. Copies of the bulletin can be secured by writing to The Bristol Company.

Electrical Instruments

The Marion Electrical Instrument Co. announces the publication of an illustrated 12-page brochure, explaining the history, uses and advantages of Marion Glass-to-Metal Truly Hermetically Sealed Electrical Indicating Instruments.

This concentrated brochure throws an interesting light on the potentialities of hermetically-sealed electrical indicating instruments for future uses in all types of electrical equipment.

For a free copy of the brochure, write to Marion Electrical Instrument Co., Dept. MF, Manchester, N. H.

Plastic Base Material

A new 12-page illustrated booklet, *Ucilon Protective Coatings*, has been published recently by *United Chromium, Inc.*, Dept. MF, 51 East 42nd St., New York 17, N. Y.

Ucilon is a new surface coating material which resists all acids in commonly used concentrations and all alkalies and salts at ordinary temperatures plus alcohols, petroleum derivatives and natural oils. It is non-toxic, non-conductive, inhibitive to fungus. It protects the surfaces of process equipment, piping, walls, beams, ductwork, tanks, etc., produces an attractive glossy finish on metals, wood or concrete and gives products subject to corrosion extra service and extra sales appeal.

Ucilon, compounded from special synthetic resins, can be brushed, dipped or sprayed like ordinary paint. Formulations for special needs such as quick drying, elasticity, matte surface, etc. are available.

Copies will be sent without charge by writing to the manufacturer on company stationery.

Associations and Societies

Society of Chemical Industry

The *American Section* of the *Society of Chemical Industry* announces the election of *Mr. Francis J. Curtis*, vice-president of *Monsanto Chemical Co.*, as chairman and *Mr. Sidney D. Kirkpatrick*, editor of *Chemical & Metallurgical Engineering*, as vice-chairman, to serve until July, 1946.

Cyril S. Kimball and *J. W. H. Randall* were reelected honorary secretary and honorary treasurer, respectively. The following were elected as new members of the executive committee: *W. J. Baeza, G. J. Esselen, C. N. Frey, R. Heggie* and *N. A. Shepard*. R. Heggie will serve as assistant honorary secretary and W. J. Baeza as assistant honorary treasurer.

Obituary

F. Archer Thompson

F. Archer Thompson, 62, head of the Detroit office of the *Bullard Co.*, machine plant at Bridgeport, Conn., died July 31 in Grace Hospital in Detroit of a heart ailment.

Mr. Thompson came to the Bullard Co. as a machine operator in 1912, became a demonstrator, and then headed the firm's standards department. After the first World War, Mr. Thompson superintended the layout of the present Bullard plant.

Mr. Thompson is survived by his wife, two sons and two daughters. One son, Wilfred Thompson, his father's assistant for many years, will be in charge of the Bullard Detroit office.

ANSWER KEY

T, F, F, T, T, T, F, T, F, T

BARBER-COLMAN

MICRO SYSTEM FOR PROCESS CONTROL

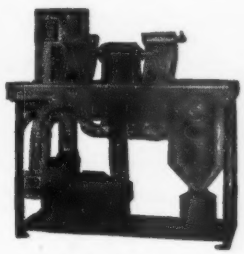
BY USING a solenoid-loaded contact tongue, with the pull of the solenoid governed by a rheostat on the valve motor shaft, the Microtherm (lower picture) is able to position the Proportioning Valve (upper picture) so as to satisfy exactly any change in demand. Features include simple construction, no relays, and maximum power at all points of valve stroke. "Hunting" is eliminated and the valve is positioned quickly with "micrometer accuracy."

Write for Bulletin

"CONTROLS FOR INDUSTRY"

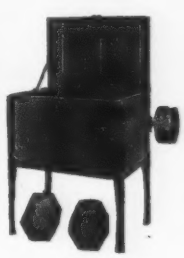
BARBER-COLMAN COMPANY
1205 ROCK ST. • ROCKFORD, ILL.

Blower

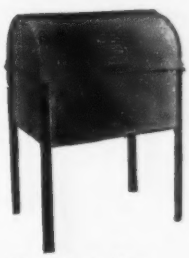


Polishing Bench

Dryer



Tubbing



Sawdust Box

Sandblast

THE BOLAND SYSTEMS FOR FACTORY INSTALLATIONS
Tanks, Coloring Rooms, Dynamos, Sawdust Boxes

H. J. ASTLE & CO., INC. Established 1884 (Send for Catalogs) 118 Orange St., Providence, Rhode Island

You *Step Up* Polishers' Production Average of 47% More Pieces per Head with

GRIPMASTER
PAT PEND
POLISHING WHEEL CEMENT

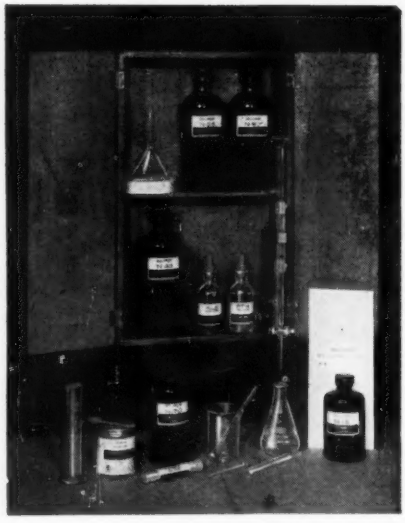
As reconversion gets under way, the efficiency of your polishing wheel adhesive becomes increasingly important. One test will prove to you . . . as it has proved to countless others . . . that Gripmaster's secret new high-heat resisting ingredient banishes glazing, steps up polishers' production an average of 47% more pieces per head! With Gripmaster, *one test tells all* . . . because Gripmaster's *one* grade grips *all* grains—250 to 20. Send for generous free sample today!

GRIPMASTER DIVISION
Michigan Bleach & Chemical Co.
12345 Schaefer Highway
Detroit 27, Michigan

IN CANADA:
Nelson Chemical Co.
Windsor, Ontario

Please send us a generous free sample of Gripmaster so we can make the *"one test that tells all."*

COMPANY_____
ATTENTION:_____
ADDRESS_____
CITY_____ STATE_____



GET READY

FOR THE RETURN OF DECORATIVE PLATING

Control Sets for Nickel, Chromium, Copper, Silver and other solutions available.

Write for Literature

KOCOUR CO.

4720 S. CHRISTIANA AVE.
CHICAGO 32

Specify Kocour Sets from your supplier.

News from California
By FRED A. HERR

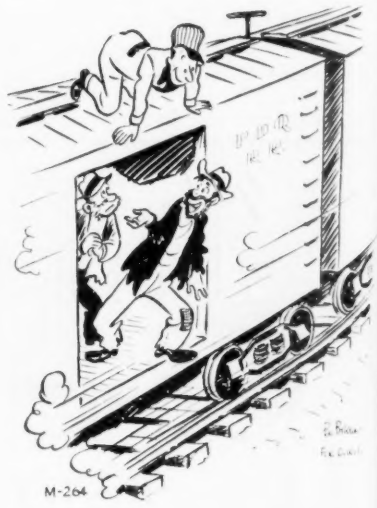
Detroit Brass Foundry, Los Angeles, ha changed its name to *Los Angeles Brass Co.*, and will manufacture under the trade mar name of "L. A. Brass," *Donald Davidson*, general manager, announced.

With its recent removal to 5142 Alhambra Ave., Los Angeles, the firm installed addi tional new equipment and a complete ma chine shop.

The sudden ending of the Japanese Wa which brought the much-discussed "post war period" to an actuality with dramatic suddenness, has had far-reaching effects on the Southern California plating industry, a discussion of which seems timely this month when most of the plating and metal finish ing organizations, resuming meetings after the summer vacation, will probably concen trate discussion at their opening fall ses sion on "what to do and how" in the post war months to come.

The Southern California metal finishing industry, led by members of Los Angeles Branch of the A.E.S., has discussed post war problems and potentialities in a gen eral way for several months. It is safe to say, however, that few expected to meet the postwar period and its multitudinous problems headon with the abruptness that was occasioned by the sudden ending of the war in mid-August.

This is written a week after the cease firing order was given by General MacArthur August 14. Initial effects of the war's end ing were felt in Southern California plat ing circles within a matter of days there after. The most noticeable effect was the sudden termination of the manpower short



M-264

"IT'S OKAY, SLUG—HE JUST WANTS TO REMIND US TO REGISTER WITH THE OPA RENT OFFICE!"

In 35 seconds a basketful of small parts can be completely dried with a

Write for information and prices.

KREIDER Centrifugal DRYER

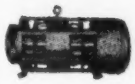
DELLINGER MANUFACTURING CO.

727 N. Prince St., Lancaster, Pa.

J. HOLLAND & SONS, Inc.

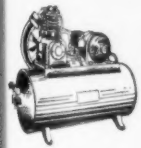
Electroplating and Finishing Equipment and Supplies

●



MOTOR GENERATOR SETS
All Sizes and Types
Rheostats 50-1500 amperes with or without meters.

V-DRIVE POLISHING LATHES
Sizes 3-15 horsepower. Complete unit is ball-bearing, totally enclosed, Sturdy construction.



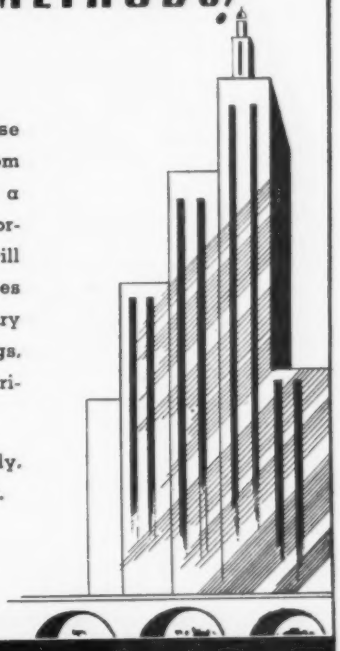
SPRAY PAINTING EQUIPMENT
Spray guns, Air compressors, Spray booths and complete paint finishing units. Baking ovens.

●

J. HOLLAND & SONS, Inc.

276 South Ninth Street Brooklyn 11, N. Y.
AT BROADWAY

MODERN INDUSTRIAL CLEANING METHODS!



Removal of heavy oils, grease and drawing compounds from steel parts often presents a difficult problem, which no ordinary cleaning material will solve. AHCOLOID 70 produces the clean surface necessary for paint, phosphate coatings, electroplating or further fabrication.

And it does its work quickly, efficiently and economically.

APOTHECARIES HALL CO.
WATERBURY 88 CONN.

AN IMPORTANT MESSAGE TO PLANT MANAGEMENT

Regarding Control of

SKIN IRRITATIONS

TARBONIS cuts absenteeism! Dermatitis due to cutting oils, chemical irritants, metal dust, etc., has been practically eliminated in many plants through the use of TARBONIS.

Not merely a protective, TARBONIS is also effective in clearing up a high percentage of stubborn skin conditions encountered in industry. Easy to apply—nothing to remove. Pleasant, odorless, greaseless, stainless.

THE TARBONIS COMPANY
4300 Euclid Ave., Dept. MF, Cleveland 3, Ohio

Please send me a good sized jar of TARBONIS and complete information.

NAME.....

ADDRESS.....

CITY.....ZONE.....STATE.....

age which plagued independent plant operators for the past several years.

For the past two years the personnel problems of platers in California has been on a par with that of big league managers. They have had to take what they could get, and make the most of it. One Los Angeles shop owner expressed the sentiments of his fraternity brothers earlier this year:

"I feel like Joe McCarthy of the Yankees," he said. "McCarthy has had to play pitchers on first base and second-sackers in the outfield. He's had to put minor leaguers in big league uniforms and groan and bear it while singles went through to the fences for triples and homers. We platers have had to put minor leaguers into our shops to handle big-league plating jobs. We've had to put men—and women—to work on polishing jobs who, I swear, never knew what a buffer looked like before entering the shop. Sure will be a relief to hire a man on the basis of experience and ability."

The millenium for which that shop operator sighed arrived in mid-August. Within a week after the Japanese surrendered, the great exodus was on from the plane plants and other war factories in which thousands of top-flight platers and polishers had been frozen to their jobs.

By August 20, Douglas Aircraft Co. had laid off some 15,000 men in its Santa Monica, El Segundo and Long Beach plants. Lockheed, North American, Northrup and Consolidated-Vultee followed suit a few days later. It was estimated that among the 50,000 workers dismissed by the plane plants, were a minimum of 500 to 600 good, experienced metal finishing workers who were made available to the smaller plating plants. This figure is regarded as conservative and represents the ratio of platers only in the initial cut-back of payrolls in plane plants alone.

Additional layoffs at the plane plants and in the hundreds of smaller factories which produced or processed parts for planes and other war products, which followed a few days later, left the plating industry of Los Angeles and its contiguous area with a pool of between 1500 and 2000 men with varying degrees of plating experience to draw from.

Cut-backs in war contracts had varying effects on the rate of dismissals. In many plants which operated plating departments as part of their activity, reduction of the metal finishing crews was not as severe as in the plane plants. Such establishments as Cannon Electrical Mfg. Co. of Los Angeles, for instance, will require a substantial crew of platers and polishers when reconversion to peacetime activity is completed. This firm may temporarily lay a considerable number of metal finish workers, but it is expected to require large staff again when it resumes pro tion of electrical connectors, panel bo etc. for civilian production.

Plants, whose war work has been lar on items which the firm also made peacetime, will have less difficult re version problems than factories which, ing the war, handled such commodities shell casings, machine gun parts, and war materials.

Typical of one plant's situation is Olds Band Instrument Co. of Los Ang This firm's switch to civilian produc will involve no major reconversion requiring a long time to bring about. firm produced horns for the Army in l quantity during the war, and while it did some work on other items, they of such nature that no big change in operation was involved. The Olds Co. cording to Joe Sunderhaus, plating man, can swing over to civilian produc with little loss of time.

During the War, the hardest hit by manpower shortage in skilled help were smaller, independent plating shops w had prewar shop crews of 10 men or including the owner. Most of such engaged in some sort of war work.

Quality Chemicals for over 50 years

PHELPS DODGE REFINING CORPORATION
NICHOLS
TRIANGLE BRAND
CHEMICALS
REG. U. S. PAT. OFF.
40 WALL ST. NEW YORK

COPPER SULPHATE
NICKEL SULPHATE
COPPER OXIDE

J & J ENGINEERING COMPANY

Builders of

INDUSTRIAL FILTERS for Electroplating solutions, oils, solvents, water and alcohol.

SALT FOG TESTING EQUIPMENT to latest Gov't. Specs.

RUBBER LINED Tanks, valves and fittings.

Try the filter with the scientifically designed air wash method of cleaning.

J & J ENGINEERING COMPANY
1819 N. New England Ave. Chicago 35, Ill.

FOR WAR PRODUCTION—FOR POST-WAR PLANS

NICKEL, CHROMIUM, BRASS OR COPPER
Electro-Bonded SHEETS · COILS TO ZINC, STEEL, BRASS, COPPER, ALUMINUM OR TIN PLATE

AMERICAN NICKELOID COMPANY - 8 Second St. Peru, Illinois

SOMMERS BROS. MFG. CO.
MFRS. OF "BEACON"
Plating and Polishing Supplies and Equipment—Complete Semi and Full Automatic Installations—Gold, Silver and Chrome Rouge, Stainless Steel and Satin Finish Compounds—Buffs, Polishing and Felt Wheels.
SAMPLES FURNISHED ON REQUEST.
3439 NO. BROADWAY ST. LOUIS 7, MO.

ODDS and ENDS

Viewing With Alarm Dept:

We have been noting, with a certain amount of apprehension, the recent tendency in the technical literature of adopting the British practice of calling plating solutions plating *baths*. First thing you know they will be calling a plating room a bath room!

From a British paper on anodes: *"In the case of nickel anodes it is interesting to note, that of the two types of depolarised anodes at present in use, one makes use of the addition of nickel to the extent of some* 0.5%." Who said the nickel situation was bad in the U. S. A.? We've seen some pretty terrible anodes in our time but we are quite sure that even the worst of them contained more than 0.5% nickel! And before anyone writes us a nasty letter about misspelling the word "depolarized," may we add that our friends across the pond spell it with an "s."

Joe dePaul (Breeze Corp.) probably isn't feeling well. He looks like the picture on his identification badge.

Credit Where Credit Is Due:

Our desk has been flooded during the last few weeks with press releases, each of them bursting with the news that the such-and-such company made important contributions to the development of the atomic bomb. These have all been filed alphabetically (in the waste-paper basket) but we will publish an admission by any manufacturer that his firm had nothing to do with this development.

Definition of the Month:

Credit goes to *George K. Scribner* (Boonton Molding Co.) who states: "It has reached the point where practically any synthetic organic material, which is not to be taken internally, is called a plastic . . ."

Name of the Month:

U. S. Patent No. 2,377,251 was granted to *Camille Clare Sprankling Le Clair* of England, who takes the crown from *Minton H. Twinch*, our former title holder.

For the Careful Reader:

In George Hogaboom's article on the "Wearing Qualities of Gold Deposits" published in our August issue, the figure 43 milligrams of gold abraded per 1,000 cycles was listed for a thickness of 0.00001. For those who check figures carefully we wish to add the comment that the figure was *calculated*.

How Much Do You Know?

(Prepared by George Black)

Designate the following as true or false:

1. Enamel coatings shall consist of a vitreous or semi-vitreous material applied in one or more coatings.
2. Coating thickness on smoothly coated areas may not be more than 0.006" thick, with 0.005" preferred.
3. There is no maximum thickness requirement for coatings at beads.
4. Enamel coatings are required to completely cover the metal on the interior as well as the exterior.
5. The specification requires that enamel coatings be free from cracks, chips and heavy beads.
6. Oxidation resistance is tested by measuring the gain in weight after heating at 1200° F. for 48 hours.
7. No sandblasting is permitted on surfaces to be treated.
8. Enamel coatings may be stripped in molten alkali.
9. Thermal shock resistance is tested by measuring loss in weight after heating and quenching.
10. The enamel coating provides good electrical insulation.

See answer key on page 401.

GRANIUM
CYANIDE
A PRECIOUS METAL COMPLEX SALT FOR THE PLATING TRADE

Renders Electro-Silver Plate Harder, Longer Lasting, Tarnish Resistant.

Easy to use. No Extra Work. Moderately Priced.

The Greatest Advance in Silver Plating in Years.

Write us for Full Information.

GRANIUM PRODUCTS
2616 DOWNEY ROAD
LOS ANGELES 11, CALIFORNIA

"Granium" is our Trade name.

Phone Angelus 1-5308

Chemical Engineers since 1905

SAVE TIME MONEY AND REJECTS

with FERRO PICKLE PILLS

Check pickling, neutralizing and metal cleaning solutions *frequently!* Keep them at top strength —and without wasting time or materials—with Ferro Pickle Pills.

With Ferro Pickle Pills, any workman can quickly determine the percentage of acid in his pickling tanks, the percentage of iron, exactly when to dump. He can also tell the strength of alkali in neutralizing baths . . . or the strength of a metal cleaning solution. Pills for still other tests are available, to order.

Write today, for full information.

FERRO ENAMEL CORP.
Pickling Division
4150 EAST 56 STREET • CLEVELAND 5, OHIO

Mail Your Orders Early for EQUIPMENT and SUPPLIES

Now is the time for you to consider your post-war metal finishing requirements and MAC DERMID INCORPORATED Service Engineers, operating from Waterbury, are equipped to service every cleaning, finishing and plating need of New England manufacturers. Phone our representative today to fill your orders on the smaller type of equipment as illustrated and listed in the following paragraph or ask for folders on the larger equipment

WELDED DIP BASKETS

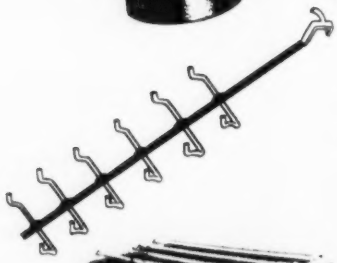
All welded construction, steady or swinging bail dip baskets in standard sizes or to specifications.

NEOPRENE GLOVES

Recommended better than rubber for toughness and acid resistance.

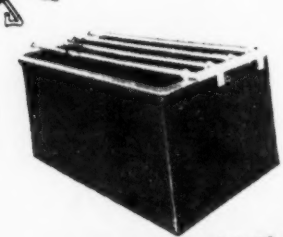
DRUMS

Synthetic rubber-lined steel drums for plating with any type acid solution—55 gal. capacity—$76.00 — F.O.B. Detroit.



PLATING RACKS

Available in various designs and construction according to requirements.



PLATING TANKS

All descriptions with various types of linings for all plating and finishing operations.

Headquarters for Metal Cleaning, Finishing and Plating Equipment For New England Manufacturers